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DEVELOPMENT OF VEHICLES-IN-USE SUBLIMIT MANEUVERS

FINAL REPORT

VOLUME I. SUMMARY

Donald E. Johnston*

ABSTRACT

Automobile sublimit performance maneuvers and measures were developed for investigating the influence of vehicles-in-use steering, suspension, and brake system degradation and tire factors on vehicle handling. The maneuvers and performance measures are directed at vehicle static and dynamic stability characteristics, vehicle controllability, driver workload, and vehicle path stability under unbalanced force or moment disturbance inputs. The NHTSA automobile simulation was modified to incorporate various steering and suspension degradations and was employed to guide selection of maneuver and component degradation levels for full-scale vehicle testing. Over 1,800 full-scale test runs were made with three passenger automobiles in assessing maneuver procedures and component degradation influences. Tests run with the Variable Steering Servo automobile are the first-known direct measurements of steering, suspension, and tire degradation influences on vehicle open-loop dynamic characteristics and on driver/vehicle closed-loop interactions.

A multi-vehicle test plan was outlined to extend the current vehicle data base, to refine the maneuvers and procedures developed in this program, and to initiate development of meaningful acceptability criteria for vehicles-in-use sublimit performance testing.

I. INTRODUCTION

A. Background

The National Highway Traffic Safety Administration (NHTSA) is dedicated to reducing fatalities and injuries on the nation's highways. A considerable

portion of the highway safety problem involves safety outages in vehicles-in-use. Past research has investigated relationships among vehicle defects and crashes (1-4),** frequency of outages (5-9), and the influence of various outages and degradations on vehicle limit performance (10-13). However, almost all driving occurs in the vehicle sublimit performance regime wherein both driver and vehicle factors influence the behavior of the driver/vehicle system. With time, the vehicle-in-use performance suffers as subsystem components deteriorate and degrade. The driver, in many instances, redresses the driver/vehicle system imbalances caused by the degraded vehicle properties by adjusting his characteristics to offset them. Thus, the total driver/vehicle system performance remains more or less constant, or only slightly modified by the deterioration. Nonetheless, this driver adaptation has its costs. They appear in the form of increased demands for driver attention, compensation, and effort and earlier onset of fatigue. Some deteriorated vehicle properties cannot be completely compensated for or offset by changes in driver behavior; these lead to degraded overall driver/vehicle *system* performance as well as excessive demands on the driver.

Suspension, tire and wheel, brake, and steering apparatus are major elements in the definition of total vehicle dynamics. Their mechanical characteristics as dynamic entities and their interactions are extremely complex. Deterioration in the components of these vehicle handling subsystems can occur in many ways. In principle, the details of the degradations in vehicle dynamic properties can be enormously complicated when viewed as a whole; but, in sublimit maneuvers, the vehicle dynamics of consequence are the special and particular properties that interact

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** Numbers in parentheses designate references at the end of the paper.

with the driver's characteristics. In other words, the important vehicle dynamic properties are those of an effective controlled element as actuated by or "seen" by the driver. These particular properties interact with the driver's dynamics to create the driver/vehicle system behavior.

The most important driving conditions of interest are those that are also critical from a driver/vehicle system standpoint. The corresponding control inputs to the car are those that represent typical driver inputs in *representative* sublimit maneuver driving, which include *abnormal* driver/vehicle system behavior. These maneuver/input combinations, and the conditions which define them, have not been thoroughly explored in the past, and results of those tests which have been performed are sometimes conflicting. However, enough has been determined in previous NHTSA programs about the effects of degraded components and tires on sublimit vehicle dynamic performance (14-17) and about driver/vehicle system interactions, including those with different sets of tires and vehicle dynamics (18-19) to permit a more definitive attempt to develop vehicles-in-use sublimit maneuvers.

B. Objectives

The four objectives of the program were to:

- Develop a set of vehicle sublimit performance maneuvers suitable for conducting research into the effects of steering, suspension system and brake component degradation, and tire factors on vehicle sublimit performance.
- Modify the NHTSA passenger automobile simulation to incorporate the component degradations and maneuvers.
- Validate the vehicles-in-use sublimit maneuvers in scale tests.
- Plan a multi-vehicle testing program.

C. Program Rationale

In an attempt to develop the relative importance of various potential component degradations in a driver/vehicle system context, the task was approached from three directions. Reports documenting accident causal investigation results were reviewed (1-4); published data from vehicle inspection and diagnostic center tests were checked for component and system out-of-tolerance frequencies (5-9); and results of

previous sublimit handling performance tests were reviewed (14-22).

One of the primary sources for accident causal data was the Tri-Level Accident Study by Indiana University (1). Results of its detailed laboratory measurement of 215 vehicles involved in accidents showed that the driver was the causal factor in 57 percent of the accidents, while the vehicle condition was causal (primary or contributory) in only 13.1 percent of the cases. The remaining 30 percent were environmentally related.

Vehicle factors were also proportioned at a detail level. In the reporting format used, only four systems were identifiable with vehicle handling. Left-right brake imbalance contributed to 2.3 percent (5 out of 215) of the accidents; tire underinflation contributed to a similar number; steering system free play (all sources) figured in only 3 of 215 cases (1.4 percent); and suspension system degradation was not considered to be a causal factor in any of the accidents.

Based on this limited sample it appears that potential vehicle factors identified are those that are readily determined and therefore obvious causal suspects—but there are few occurrences. It also is suspected that many driver/vehicle *interactive* causal factors are undetected and are currently only listed as driver related.

Results of diagnostic center and vehicle inspection studies (6, 7, 9) involved approximately 26,000 vehicles that were inspected to manufacturers' specified tolerances, state/local motor vehicle requirements, or, in some instances, limits that have been shown to be "satisfactory" in practice. Despite the sometimes widely varying inspection and reporting procedures, the data are remarkably consistent regarding the preponderance of alignment (caster, camber, and toe) and shock absorber outages. The relative occurrences of outages in brake imbalance, tire inflation, tire tread, and steering play are much less and are consistent with the accident causal ratios noted above. Again, this may be related to use of similar outage criteria. These data tend to indicate that either the tolerances for alignment and shocks are overly tight or these degradations produce subtle vehicle changes not readily apparent to the driver and which are therefore not corrected. In regard to the latter, the total lack of front end suspension and alignment as potential accident causative factors may be due to front end damage, which makes it difficult to establish pre-

accident status. The relatively high occurrence of such outages in diagnostic center inspections points to the need for maneuvers and measures sensitive to subtle as well as obvious component degradation influences.

The third approach was the review of past vehicle-in-use *sublimit* maneuver test results. Five programs (10, 11, 14, 16, 19) have applicable results, some of which were obtained as a subset to limit performance testing. The most comprehensive test was that discussed in reference 16, which was totally devoted to mechanical component degradations (not tire considerations). The maneuvers involved open-loop (fixed steering and closed-loop (steering control) transit of a severe roadway disturbance obstacle course, agility tests (lane change and random slalom), and straight-line braking. Component degradation influences on a single vehicle were determined singly and in various combinations and levels. The large vehicle inspection outage components (shocks, caster, and camber) had relatively small influence as determined by handling performance metrics. On the other hand, toe-out (15/32 in.), loose steering (40° at steer wheel), worn ball joints (greater than 0.1 in.), and front brake imbalance (30 percent) produced a large handling degradation in one or more of the test maneuvers.

The investigation discussed in reference 11 contained one sublimit maneuver in an otherwise limit maneuver test program. This involved determination of alignment effects on vehicle handling in an obstacle avoidance maneuver. Six vehicles were tested. Results indicate caster, camber, and toe have little influence on vehicle handling. Limit performance maneuver results also showed significant disagreement with the findings discussed in reference 15 for ball joints.

Available data on tests of brake imbalance (14, 16) and tire influence (10, 19) are in general agreement. The tests discussed in reference 14 involved a number of vehicles and drivers (novice to expert) and investigated side-to-side brake imbalance levels up to 100 percent at the front and rear wheels. Front imbalance had large influence on vehicle path stability (as also shown in reference 16). Rear imbalance had considerably less influence. The tire tests showed that the front-to-rear side force stiffness ratio ($Y_{\alpha_1}/Y_{\alpha_2}$) has a dominant influence on vehicle handling in either open- or closed-loop testing.

Based upon the literature search it was concluded that:

- Accident investigation measures
 - Tend to focus on vehicle causative factors that are obvious.
 - May preclude identification of front suspension and alignment accident causative factors because of accident-related front-end damage.
 - May not adequately identify subtle driver/vehicle causative interactions.
- Outages reported in vehicle diagnostic inspection studies
 - Show a preponderance of shock absorber and front-end alignment discrepancies.
 - Are relatively consistent across studies.
 - May point to driver/vehicle accident causative factors.
- Past sublimit performance maneuvers have proven useful in identifying influences of the more dominant component degradations.
- Maneuvers and measures sensitive to subtle as well as obvious component degradation influences are needed.

II. TECHNICAL APPROACH

Technical objectives of this program imply a potentially immense number of experimental test conditions because they imply three investigational dimensions:

- Vehicle degraded components
- Vehicle maneuvers
- Roadway disturbance features.

Each dimension offers nearly limitless opportunity for infinite variety. To pursue the program by attempting to enumerate exhaustively and then investigate the possibilities would be impossible as a practical matter. Rather, a pragmatic approach which imposes greater discipline upon the investigation, is required.

From the standpoint of driver/vehicle interaction, the degradation factors may be divided into two categories: continuous acting and pre-loaded or normally inactive.

Continuously acting degradations relate to shocks, alignment, steering wheel play, and tires. These generally result in slow, perhaps subtle, changes in vehicle dynamic characteristics to which the driver adapts on

a continuous basis. He therefore may not recognize reduced performance or stability margin unless he suddenly changes from a second, undegraded vehicle. In the extreme, these degradations can result in driver-induced or continuous oscillation.

Normally inactive degradations are those whose effect is normally pre-loaded out by static or trim forces and torques acting within the system. A specific maneuver or side force is required to overcome the preload. When this is encountered, the element then can snap to a new position. The result is a step change in vehicle response or stability and the potential for driver overreaction.

The influence of a quasi-linear, continuous acting degradation on key vehicle dynamic parameters (identified in references 18 and 20) can be accurately determined by cross-correlation techniques providing continuous measures of the system input (or forcing function), and the key response variable can be obtained. Such measures are provided and automatically processed onboard a specially equipped 1974 Nova called the Variable Steering Servo (VSS) car (18). Both open-loop (fixed steer) measures of the vehicle-alone dynamics and closed-loop (driver-in-the-loop) measures of driver/vehicle interaction are possible.

The influence of snapthrough-type degradations can be readily quantified by measures of change in vehicle steady-state response during fixed steering input encounters with preprogrammed disturbances (brake input or roadway induced). This type of maneuver is readily accomplished via a less extensively instrumented vehicle and/or the NHTSA simulation.

Thus, a three-step approach was adopted to develop sublimit maneuvers and performance measures that are sensitive to and result in quantification of the influence of component degradation in vehicle handling qualities. The first phase involved use of the VSS car to provide direct measurement of the change in vehicle dynamic parameters introduced by quasi-linear component degradations. Also, the effective stability factor, k (deg/g); was varied via feedback of lateral acceleration to the VSS servo. This allowed driver-in-the-loop experiments to establish the minimum perceptible and maximum acceptable change in vehicle understeer/oversteer from the driver standpoint. These benchmarks served to establish further the proper perspective on component degradation influences.

The second phase involved investigation or snapthrough-type degradations via open-loop maneuvers on the NHTSA automobile simulation (21). Modification of the simulation was required to model appropriate degradation effects. A series of steady maneuvers was then performed to determine influences of these degradations and to predict maneuver levels to exercise snapthrough.

These preliminary phases served to eliminate from further consideration those maneuvers and degradations having little influence and to refine gradually the surviving maneuvers and performance measures. The final phase was a full-scale test program using two 1975 sedans to validate simulation results, refine the maneuvers, and determine procedures most appropriate to the multi-vehicle test program.

III. PRELIMINARY TESTS

The VSS car and its instrumentation system provide a means for identifying vehicle dynamic characteristics that previously has not been available for investigation of vehicle-in-use degradation influences. It facilitates direct identification of baseline vehicle dynamic parameters as well as the change in these parameters introduced by continuous-acting steer/suspension/tire component degradations. It provides a unique capability for measurement of driver/vehicle closed-loop dynamic interaction utilizing the real driver and vehicle and an artificially augmented vehicle to vary stability and controllability.

Therefore, the three principal goals of the preliminary tests were to:

- Identify and quantify change in vehicle dynamic characteristics resulting from the introduction of continuous-acting steer, suspension, and tire degradations.
- Determine, through means of the variable stability feature, the minimum perceptible and maximum acceptable change in vehicle stability factor (K).
- Eliminate from further consideration component degradations eliciting little or no change in vehicle open- or closed-loop dynamic characteristics.

A. Vehicle

The VSS vehicle is a 1974 Chevrolet Nova. Prior to initiation of tests, the steering and suspension

systems were renovated, and new tires were installed. The car is equipped with an electrohydraulic servo mounted in series between the pitman arm and the transverse link (relay rod) of the steering linkage. The purpose of the electrohydraulic actuator is to apply electrical steering inputs to the front wheels independently of the driver's steering inputs. The electrical inputs include random-appearing voltages from an onboard signal generator (to simulate random roadway or gust disturbances), steering wheel position voltage (which effectively changes the vehicle steering ratio), and various motion feedback signals from the inertial instrumentation (e.g., lateral acceleration) to alter the vehicle's static and dynamic stability.

B. Test Maneuvers

Quasi-linear-type degradations affect vehicle steering handling through alteration of any of four basic handling characteristics: steady-state gain, dynamic stability, directional trim, and agility. The five basic maneuvers used to provide open- and closed-loop measures of these characteristics are summarized in Table I. Each maneuver was performed with the vehicle in original-equipment condition and with single and combined degradations.

The step steer, random disturbance, and double lane change maneuvers were also performed with the baseline vehicle under/over-steer characteristic artificially altered by means of lateral acceleration feedback to the steering servo. The range of values investigated was $-1 < K < 25^\circ/\text{g}$. Steer ratio (gain) was kept

nearly constant during these tests by feeding the steer wheel position electrical signal to the electrohydraulic servo at an appropriate gain.

C. Open-Loop Test Results

The open-loop tests consisted of the step steer, steer-fixed random disturbance, and steer returnability maneuvers; they are discussed below in that order.

1. Step Steer. The step steer maneuver and stability factor (K) performance measure proved highly sensitive to change in vehicle configuration. Degraded component testing was preceded by a series of tests with the baseline (original-equipment) vehicle employing tires with different wear levels, tire location rotation, and vehicle left-right passenger loading and with the vehicle stability factor artificially altered using feedback of lateral acceleration to the electrohydraulic steering servo.

a. Baseline Vehicle. Two sets of tires identical in every aspect except that one had been driven 1,000 miles and the second approximately 500 miles were used. The vehicle exhibited a stability factor range of $5.8 \pm 1.2^\circ/\text{g}$ with the two sets of tires. Within that band, left-right switching of the wheels and/or cross-rotation produced a left-right stability factor differential of up to $1^\circ/\text{g}$. Altering vehicle loading by adding a (simulated) 240-lb. front passenger produced a left-right stability factor differential of approximately $2.5^\circ/\text{g}$. These changes in vehicle understeer gradient were *not* apparent to the driver.

TABLE I
VSS TEST MANEUVERS

Characteristics	Maneuver	Speeds	Major Measures
1) Steady-state gain (under/over-steer K factor)	Step steer, left and right ($0.15 < g < 0.43$)	30-60	Velocity (U_0) r steady state Front wheel angle (δ_{w0}) Steer wheel angle (δ_{sw0})
2) Yaw dynamic stability parameters	Random disturbance a) Fixed steer wheel b) Lane regulation	30, 50	Yaw rate response amplitude and phase frequency response a) Vehicle only b) Vehicle plus driver
3) Directional trim (open-loop returnability)	Turn exit	30, 40	r transient Front wheel angle (δ_{w0})
4) Agility (maneuverability)	Double lane change	30, 50	r , a_y , φ transient Steer wheel activity (δ_{sw0}) Cone strikes

Using lateral acceleration feedback to the servo, the vehicle stability factor was set to $5.0^\circ/\text{g}$ and then varied to determine minimum perceptible K variation for the test driver. In one test the stability factor was randomly changed in $5^\circ/\text{g}$ steps from $0^\circ/\text{g}$ to $+15^\circ/\text{g}$. The driver could correctly identify the *direction* of change (i.e., more understeer or less understeer) five out of seven times but could not identify the K value correctly in any instance. A second set of tests involved $\Delta K = +3^\circ/\text{g}$ with the vehicle returned to original equipment between each run. The driver correctly identified the *direction* of change seven out of seven times. Thus the test driver had a minimum ΔK threshold of between 3 and $5^\circ/\text{g}$, which is compatible with not being able to detect a $2.5^\circ/\text{g}$ change due to tire and vehicle loading influences.

b. Degradation Influences. A total of 24 quasi-linear degradation configurations and levels was investigated. Maximum variations employed are summarized in Table II. Extreme values were selected in each case to assure better that some influence on vehicle dynamics might be detected. The initial levels were based upon previous tests (11, 12, 16). In a few instances this produced so little influence that larger values were selected. Shock absorber and tire inflation degradations were employed on one front, asymmetric front/rear, both front, and both rear locations.

While each degradation produced measurable change in stability factor, nearly all resulted in less variability than obtained with the above-noted tire changes and passenger loading ($\pm 1.2^\circ/\text{g}$) and were well within the driver's threshold of perception.

The degradations producing significant change were low inflation on both front tires ($K \pm 10^\circ/\text{g}$) and 7/8-in. toe out ($K \pm 8^\circ/\text{g}$). When these two degradations were combined, the low tire inflation influence predominated (i.e., $K \pm 10^\circ/\text{g}$).

2. Random Disturbance. The VSS sum of sine wave disturbance input with driver steering wheel fixed produced measures of the vehicle-alone dynamic parameters in yaw. If the vehicle dynamic response is effectively two degrees of freedom, these dynamic parameters are related to the static understeer/oversteer gradient (K), and this maneuver provides a separate but frequency-dependent measure of K .

Variation in measured vehicle dynamic characteristics due to the extreme steer free play, shock

absorber, and tire inflation degradations employed were only slightly greater than the run-to-run variability obtained with the undegraded baseline vehicle. All alignment degradations produced no discernible difference from the baseline vehicle.

These results are supportive of those obtained from the step steer maneuver, indicate the compatibility of the two test procedures in defining the change in vehicle static and dynamic stability, and indicate that the step steer maneuver is the more sensitive (and conservative) of the two test procedures. Or, put another way, the change in vehicle dynamic characteristics induced by quasi-linear degradations, while small, is most prevalent at lower maneuvering frequencies.

3. Steer Returnability. This maneuver consisted of a sudden release of the steering wheel while in steady turns to the left and right. The performance measure was the percentage return of the front wheel steer angle to neutral (straight line path). Eighteen degradation configurations and levels were investigated.

The test proved sensitive to asymmetric camber, caster, and shock degradations. These significantly accentuate left versus right returnability. The cases were also evaluated subjectively by the driver, who indicated rapid acclimation to the steering wheel "pull" of all but the asymmetric camber and caster case.

D. Closed-Loop Test Results

Closed-loop evaluations were made for degradations showing the greatest influence in open-loop testing: 7/8-in. toe-out, asymmetric caster, low front tire inflation (left and right), 7/8-in. toe-out and low front tires, and low fluid shocks (all). In addition, 40° steer free play was tested. All were assessed relative to the original-equipment configuration. The two test maneuvers were driver regulation against random disturbance inputs and a double lane change.

1. Regulation Against Random Disturbance. In this test the sum of sine wave inputs to the electrohydraulic servo produces a vehicle motion appearing to the driver as wander caused by gusts or roadway unevenness. The driver is required to steer against the disturbance and negotiate a straight, 10-ft.-wide lane for a distance of approximately $1/2$ mile. Thus, the measure is one of relatively low lateral acceleration.

TABLE II
MAXIMUM VARIATIONS INVESTIGATED; CONTINUOUS ACTING DEGRADATIONS

	OE	A	B	C	D	E	F	G	H	I	J	K	L	M
Toe in/out	$\frac{1}{8}$ " In	$\frac{1}{8}$ " Out	1" In	—	—	—	—	—	—	—	—	$\frac{3}{4}$ " Out	—	—
Left camber	$-1/4^\circ$	—	—	$-2-1/4^\circ$	$-1-1/8^\circ$	$-2-1/8^\circ$	$-2-1/8^\circ$	$-2-1/8^\circ$	—	—	—	—	—	—
Right camber	$-1/4^\circ$	—	—	$-2-1/4^\circ$	$+1-3/4^\circ$	$-2-1/8^\circ$	$-2-1/8^\circ$	$-2-1/8^\circ$	—	—	—	—	—	—
Left caster	$+1/2^\circ$	—	—	—	—	$-3-1/2^\circ$	$+4-1/2^\circ$	$+5-1/2^\circ$	—	—	—	—	—	—
Right caster	0°	—	—	—	—	$-3-1/2^\circ$	$+4-1/2^\circ$	-4°	—	—	—	—	—	—
Shock fluid	100%	—	—	—	—	—	—	—	10%	—	—	—	—	—
Shock rod guide and piston	New	—	—	—	—	—	—	—	—	Worn	—	—	—	—
Tire front	28 psi	—	—	—	—	—	—	—	—	—	12 psi	12 psi	—	—
Tire rear	28 psi	—	—	—	—	—	—	—	—	—	—	—	12 psi	—
Steering freeplay	6°	—	—	—	—	—	—	—	—	—	—	—	—	40°

The principal performance measure is the open-loop describing function of the driver and vehicle, $Y_D Y_C$, which is derived from cross correlation measures obtained onboard the vehicle during the closed-loop control task. The describing function provides direct information as to any change in driver workload (system gain), dynamic performance (system bandwidth), and overall stability (system phase margin).

This test showed that low fluid shocks and steering free play degrade vehicle handling. Both degradations increased drivers steering workload: 300 percent for 40° steering free play and about 75 percent for low fluid shocks. In addition, low fluid shocks reduced the driver/vehicle response bandwidth, while steering free play significantly reduced driver/vehicle stability. With the steer free play the vehicle actually exceeded the lane width on several occasions.

Severe toe out, asymmetric caster, and low front tire inflation did not appreciably alter driver/vehicle closed-loop characteristics or performance.

2. Double Lane Change. In contrast to the above low lateral acceleration maneuver, the double lane change was a relatively high lateral acceleration maneuver. The lane width was 9-ft. with cone demarcation at 10-ft. intervals. When negotiated at 50 mph, peak lateral acceleration reached 0.7 g. Two performance measures were used: lane marker cone strikes and the number of steering wheel reversals through neutral. Steering wheel activity by itself reflects driver workload, while the combination of steering activity and cone strikes reflects vehicle controllability.

Results of this test showed degradations producing increased understeer characteristic (sluggish directional response) produced an increase in cone strikes with a reduction in steering reversals through neutral. The low front tire inflation case ($K \doteq 10^\circ/\text{g}$) predominated. At the other extreme, degradations producing decreased system stability (bandwidth and/or phase margin) resulted in an increase in cone strikes with an attendant increase in steering reversals through neutral. The low fluid shocks predominated in this case. Steering wheel free play produced a significant increase in steering workload (reversals) without significant change in vehicle controllability (cone strikes).

Severe toe out and asymmetric caster also produced measurable change in both cone strikes and steer reversals when compared with the original-equipment configuration. Thus, this test maneuver and performance metric show considerable promise for vehicle-in-use handling.

E. Conclusions

Results of the open-loop tests showed that:

- The step steer test is a relatively sensitive and simple test for effect of component degradation on vehicle stability factor.
- Determination of stability factor (K) is a simple alternative to the sophisticated random disturbance describing function test of vehicle dynamic characteristics.
- Tire load, wear, and inflation conditions far overshadow all alignment and shock degradation effects on vehicle over/under-steer characteristics.
- Extreme misalignment and shock degradations are required to influence vehicle static and dynamic stability noticeably.
- Asymmetric alignment or component degradations can cause large difference in left/right static stability.
- Steer returnability appears a viable maneuver for detection and quantification of asymmetric degradations.

Results of the closed-loop tests showed that:

- The moderate to high lateral acceleration double lane change maneuver is a relatively sensitive and simple test for effect of component degradation on driver workload and vehicle controllability.
- Extreme misalignment produced negligible degradation in vehicle closed-loop handling.

IV. SIMULATION

The computer simulation subtask encompassed modification of the NHTSA HVHP CARD simulation program (21) to permit inclusion of key component degradation effects, validation of the two vehicle models employed in the simulation, and, finally, the accomplishment of open-loop snapthrough-type degraded component/sublimit maneuver parametric studies to guide full-scale test planning.

A. Simulation Modification

Three fundamental changes to the simulation were required. One involved provision for various free play and force threshold degradations. A second involved provision for other than horizontal tire contact patch orientation. The third involved provision for additional roadway disturbance features.

Detailed equations and implementation suggestions for the modifications were provided to the Applied Physics Laboratory (APL), Johns Hopkins University. Actual programming was provided by personnel of the APL. Validation of the modifications was accomplished on an item-by-item basis to assure proper functioning.

B. Vehicle

Two 1975 vehicles (Chevrolet Nova and Ford Torino) were specified by the NHTSA to be used in

the simulation and final full-scale testing. Simulation validation was accomplished for each vehicle via direct comparison of key time response traces for straight line brake, brake-in-turn, step steer, and sine steer maneuvers. Stability factor (K) was computed from the step steer tests and also compared.

C. Simulation Matrix

The purpose of the simulation was to assess the ability of various maneuvers and roadway disturbances to exercise snapthrough or step-type steer, suspension, and brake degradations and the resulting influence on vehicle open-loop response. Two continuous-acting degradations (low fluid shocks and extreme toe out) were also rechecked with selected maneuvers and roadway disturbances. The matrix of maneuvers and degradations tested is shown in Table III, and the degraded vehicle modes simulated are summarized in

TABLE III

DEGRADATION AND MANEUVER OR ROADWAY DISTURBANCE COMBINATIONS SIMULATED

	<i>Wind-Up Turn</i>	<i>Straight Line Brake</i>	<i>Brake In Turn</i>	<i>Lane Change</i>	<i>Turning Over Bump Grid</i>	<i>Hump Disturbance</i>	<i>Longitudinal Seam Traverse</i>
1 Worn unloaded ball joints	×	×				×	
2 Worn tie rod ends	×	×				×	
3 Loose wheel bearings	×	×				×	×
4 Steering free play	×	×				×	×
5 Low damping shocks				×	×		×
6 Front brake imbalance		×	×				
7 Toe out				×			×
8 Low damping shocks + toe out				×			×
9 Steer free play							
+2							×
+2 and 3							×
+2, 3, and 7							×

Table IV. Because of budget limitations, component degradation influences were only examined with the simulated Nova.

D. Results

1. Wind-Up Turn. Vehicle turn rate was steadily increased to induce force reversals within the degraded steering and suspension system elements. Effects on vehicle yaw rate, lateral acceleration, or trajectory were imperceptible.

2. Straight Line Braking. As would be expected, results of this maneuver are influenced by front brake imbalance. Significant reduction in longitudinal deceleration (0.17 g maximum at 100 percent imbalance) and change in vehicle trajectory (6.8°/sec maximum) away from the degraded brake were observed. Effects of degraded steering and suspension system elements were imperceptible in this maneuver.

3. Braking in Turn. This maneuver intensifies the influence of front brake imbalance when the turn direction is away from the degraded brake. Rear inside wheel lockup tends to occur when outside front braking effectiveness is reduced. Increasing initial turn lateral acceleration increases the tendency to inside rear wheel lockup and subsequent vehicle spin. Turning into the degraded brake produced little or no trajectory disturbance.

4. Lane Change. The simulated lane change was accomplished via a sine steer input producing 0.3 and 0.5 g peak lateral acceleration. Results were in substantial agreement with those obtained in the VSS vehicle tests. The low fluid shocks induced greater vehicle roll and open-loop trajectory deviation in comparison to the baseline vehicle. This implies an increase in required steer activity to accomplish successfully the closed-loop maneuver, as was the case in the VSS tests.

The severe toe out produced no perceptible change in vehicle response during the maneuver. Again this is in substantial agreement with the previous VSS test.

5. Turn on Bump Grid. Bump grid spacings of 25, 50, and 100 in. were traversed in a 0.3-g turn (undisturbed). Low fluid shocks were investigated singly and in various combinations. Results showed the maneuver to be an adequate test for degraded shocks and, in particular, low fluid rear shocks with

TABLE IV
SUMMARY OF SIMULATED DEGRADATIONS

<i>Component</i>	<i>Degradation Level</i>
Worn unloaded ball joints --	Linear free play 0.07 in. end to end; equivalent to an end-to-end camber change of 0.364°
Worn tie rod ends -----	Linear free play each side, 1/16 in. inboard plus 1/8 in. outboard equals 3/16 in. end to end; equivalent to 1.72° of steer angle end to end
Loose wheel bearings ----	Equivalent to an end-to-end camber change of 2.0°
Steering free play ---	40° end to end at steering wheel rim; equivalent to 2.0° of steer angle of road wheels end to end
Low damping shocks -----	No viscous damping; coulomb damping retained
Front brake imbalance ---	Braking effectiveness of one front wheel reduced to 70, 40, or 0 percent of normal level on inside or outside of turn
Toe out -----	2.18° each wheel; equivalent to 2.0 in

widely spaced bumps. However, the severe jouncing of the upsprung masses and subsequent degradation in tire cornering stiffness dominate the vehicle behavior and tend to mask the other degradations of interest in this program.

6. Hump Disturbance. A $(1 - \cos X)$ hump 4 in. high and 48 in. wide was traversed at a small intercept angle to produce side force at the tire patch and hence exercise the degraded steering and suspension system elements. Steering system free play allowed the front wheels to deflect at the disturbance crown and induce a proportionate deviation in vehicle path.

The disturbance traverse with worn ball joints or loose wheel bearings had no perceptible influence on vehicle response.

7. Longitudinal Seam Traverse. A 1-in-high longitudinal seam was traversed at a small intercept angle, again to produce side force at the tire patch and exercise degraded steering and suspension system elements. The undegraded vehicle was found to redirect and follow the seam for intercept angles less than 3.5°. Steering free play and severe toe out, singly

or in combination, increased the tendency for vehicle redirection for intercept angles up to 6°. All other degradations produced no change from the baseline vehicle response.

V. FINAL TEST

The purpose of the final test phase was to validate (full-scale test) and refine the vehicles-in-use sub-limit maneuvers and snapthrough degradations devised in the computer simulation. Since the VSS was employed in lieu of simulation to investigate quasi-linear type degradations and appropriate test maneuvers, these tests were not repeated. However, some additional maneuvers were adopted from those of a concurrent NHTSA research program (22) that was devoted to determining the influence of roadway disturbances on vehicle handling.

A. Vehicles

The new 1975 Nova and Torino were employed in the tests. Each had been driven less than 1,000 miles at the initiation of testing. The vehicles primarily differ in steering system geometry, front and rear suspension, and weight. Each was appropriately instrumented and then checked for weight, balance, and manufacturers' recommended alignment. Two weight configurations were employed: curb weight plus 300 lb. and near-capacity weight.

B. Instrumentation

The instrumentation included a full complement of inertial instruments, displacement sensors at each wheel, steer wheel displacement and rate, left front wheel steer angle, velocity, and brake line pressure. An electro-pneumatic brake pedal force servo and steer wheel deflection stops were employed to produce repeatable input amplitudes.

C. Test Maneuver

Three maneuvers were selected on the basis of the computer simulation: lane seam traverse, hump traverse, and brake-in-turn. A roadway edge drop-off and climb maneuver could not be successfully simulated but was adopted on the basis of the reference 22 roadway disturbance test results. A fifth maneuver, a single sharp bump in a turn, was also adopted from reference 22.

1. Lane Seam. A simulated roadway lane seam was made up of 150-ft. of 1 in. x 12 in. wooden

planking laid out at a shallow angle to a 12.5-ft. lane delineated with cone markers. The intercept edge of the planking was rounded to produce a smooth, uniform climbing surface. The initial approach was at 3.5° angle (based on simulation results) at 30 and 40 mph. Both open-loop (steer fixed) and closed-loop (steering control) traverses were employed.

2. Hump Traverse. The hump traverse initially involved a straight path crossing a simulated railroad bed elevation at an angle of 45°. Traverses were made at 25 and 30 mph through a 12.5-ft.-wide lane marked with cones. The maneuver was later modified to a 0.4-g turning traverse that intercepted the hump at 45° and still later a 1.5-in.-high bump was added at the crest. Fixed steer and closed-loop control traverses were employed.

3. Brake-in-Turn. Brake pedal pressure to produce a 0.5-g deceleration in the baseline vehicle was applied in a step manner while in a steady 0.35-g lateral acceleration turn. The tests were conducted open loop to provide a measure of the initial lateral disturbance experienced upon brake application. These were conducted without lane demarcation. Closed-loop tests required steering to stay within a curved (350 ft. radius) 12.5-ft.-wide lane laid out with rubber cones.

4. Lane Edge Climb. The earth surface next to the pavement was 3½ in. lower than the concrete surface. After dropping the wheels on one side off the pavement edge, the vehicle reapproached the edge at a shallow angle until both front and rear wheels scrubbed the pavement edge simultaneously. A ramp steer input was then made until the front wheel climbed the edge. The driver then steered to maintain the vehicle within a normal 12.5-ft.-wide lane. The maneuver was performed at 35, 40, and 45 mph.

5. Bump-in-Turn. A single 1.5-in.-high full lane width bump was encountered during a 0.4-g turn at 40 mph. Open-loop runs were conducted to determine vehicle transient response. Closed-loop tests provided a measure of driver workload to stay within a 12.5-ft.-wide lane.

D. Component Degradation

The component degradations employed are summarized in Table V. All degradations investigated in the simulation were carried through into the final full-scale testing except loose wheel bearings. The latter showed essentially no influence in the simula-

TABLE V
FINAL TEST DEGRADATION

<i>Degradation</i>		<i>Nova</i>	<i>Torino</i>
Total steering gear free play		30°	42°
Loose tie rod ends free play	Side to side	1/16" each	1/32" to 3/64" each
	Ball stud axial	1/8" each	0.20" to 0.40" each
	Maximum equivalent angle at each front wheel	1.1°	0.8°
Worn lower A-arm bushing	Total lateral free play	±0.25"	±0.25"
	Maximum equivalent angle at each wheel, with car weight on suspension	2.2° Understeer direction in cornering	2.2° Oversteer direction in cornering
	Lateral free play	1/16"	4/64" to 9/64"
Upper suspension arm ball joint	Ball stud axial (up and down) free play	3/16"	0.9"
Left front brake	Pressure reduction (%) (imbalance)	75%	75%
	Line lag	1 sec	1 sec
Toe out		1"	1"
Rear shock absorbers		90% fluid removed, zero damping	90% fluid removed, zero damping

tion and was eliminated. Worn lower A-arm bushings were not investigated in the simulation but were added for the full-scale testing.

Steering free play was induced by backing off the steer box adjusting screw to simulate wear between the steer box sector and rack teeth.

Tie rod end free play was accomplished by removing the springs within each of the tie rod ends.

Worn lower A-arm bushing was simulated by removing approximately 90 percent of the rubber from each lower A-arm bushing.

Unloaded ball joint free play was induced by disassembling the ball joint, removing the spring, and reducing the diameter of the ball stud.

Side-to-side brake imbalance was achieved by limiting left front brake line pressure to a percentage of the right line pressure via an electrically triggered solenoid.

Hydraulic pressure lag at the left front brake was induced by routing hydraulic fluid through a partially crushed segment of copper brake line.

The tie rods were adjusted until a minimum of 1 in. toe out was achieved.

The rear degraded shocks for the 1975 Nova were specially fabricated and calibrated by Monroe with 10 percent of normal damping fluid. The Torino rear shocks were modified from original-equipment replacement configuration by tapping and draining approximately 90 percent of the damping fluid.

In addition to the above individual degradations, the following combinations were employed: tie rod end and ball joint play; worn lower A-arm bushings and low fluid rear shocks; and steering free play and front brake imbalance.

Tire inflation and/or worn tread degradations were excluded from these tests at the specific request of NHTSA.

E. Test Results

All maneuvers were run with baseline, tie rod end play, and low fluid rear shocks in the light and heavy weights for both vehicles. In each case results showed that the heavy-weight vehicles are less sensitive to degradation and maneuver influences than the light-weight vehicle. Therefore, heavy-weight testing was carried no further.

The combination of tie rod and upper ball joint free play was run only with the Nova. Results of these tests supported simulation findings that the worn ball joints had no influence on vehicle handling. Therefore, worn ball joint tests were carried no further.

1. Roadway Seam Traverse. Results were essentially the same with the baseline and degraded vehicles. The initial intercept angle of 3.5° had to be reduced to 0.64° before redirection was obtained at 30 mph, and then the redirection was due to the tires refusing to go down off the board after initially climbing the small rise. Any larger intercept angles resulted in the vehicle rapidly climbing upon and dropping off the board with essentially no disturbance in path. At 40 mph the vehicle passed over the board with no redirection or swerving, regardless of intercept angle.

Because of these rather negative results, a section of actual pavement seam was sought for comparison. One was found that had a coarse-finish concrete roadway and a blacktop shoulder section. The latter had settled about 0.5 to 0.75 in. below the concrete surface for a distance of approximately 300 ft. Tests were run at 20 and 30 mph with the car aligned approximately 1° from the seam. These runs also produced no detectable difference between baseline and degraded vehicle responses.

The full-scale test did not validate the APL simulation results. It appears that a deformable tire model and appropriate tire parameters will be required before the APL simulation can be expected to forecast actual vehicle responses to lane seam type roadway disturbances.

2. Hump-in-Turn. As indicated previously, the initial maneuver was a straight line hump traverse, which elicited little difference in vehicle response with degradations other than low fluid shocks. It was then modified to a turning maneuver but produced essentially the same results. Only degraded rear shocks produced significant change in vehicle response but,

even then, the vehicle would not exceed the 12.5-ft.-wide lane in open-loop passes unless the speed was so high as to cause the rear wheels to leave the ground at the hump crest. Vertical acceleration disturbances of -0.6 to 0.7 g were recorded at the crest of the hump and over $+1.0$ upon "landing." Thus the maneuver approached limit-performance conditions. In closed-loop passes it still was not difficult to maintain the vehicle within the lane.

With the bump added at the crest of the hump a significant excitation of the unsprung mass was created at the instant of maximum vehicle unloading. This produced severe rear axle hop with degraded shocks and resulted in the vehicle going completely out of its lane. Again the maneuver was essentially limit-performance and produced little definitive information from a vehicle handling standpoint.

3. Lane Edge Climb. This maneuver produced differences in driver/vehicle closed-loop response with the Torino and certain degradations. The Nova response proved relatively insensitive to steering and suspension system degradations. In all instances the initial climb transient (yaw rate, lateral acceleration, steer input, etc.) was essentially the same for the undegraded and degraded vehicles. The principal differences came to light in the subsequent closed-loop task of maintaining the vehicle within its lane. Although the experienced driver was able to maintain either vehicle within the 12.5-ft.-wide lane after the climb, there were obvious differences in closed-loop stability and damping. The key performance parameter is the ratio of the two-peak yaw rate excursions following the edge climb. The greater the second (and subsequent) yaw rate peak, the less the stability and damping. Results are speed dependent, and the steepness of the curve connecting response (or damping) ratios at increasing speed indicates the rapidity at which the driver/vehicle combination is approaching directional instability with the various vehicle configurations. Results indicate sensitivity of the driver/vehicle response to three specific degradations: loose (or worn) A-arm bushings; loose bushing combined with low fluid shocks; and loose tie rods. Unfortunately, equal or greater response variability was obtained (23) between different classes of vehicles (compact to full size) in original-equipment condition than was obtained between the original-equipment and severely degraded vehicles in these tests.

A major problem with this maneuver is the difficulty in repeatedly accomplishing a good "scrub"

of front and rear wheels against the roadway edge and the dependence of the resulting climb and recovery maneuver upon obtaining a gradual scrub.

4. Bump-in-Turn. The measure of vehicle open-loop disturbance is the ratio of peak yaw rate after the bump encounter to the steady-state yaw rate. The closed-loop task measure is the peak steer deflection required to maintain the vehicle within its lane.

This maneuver is easy to perform, provides good repeatability, and is sensitive to both snapthrough and quasi-linear type degradations. It induced a strong tendency to oversteer with low fluid rear shocks (both vehicles) and loose A-arm bushings (one vehicle) and an equally strong tendency to plow out with tie rod end play (one vehicle).

5. Brake-in-Turn. The brake-in-turn maneuver produced quite severe understeer and oversteer transients that depended upon level and combination of degradation employed, direction of turn, etc. The open-loop maneuver produced detectable transient response differences in both vehicles. However, in closed-loop tests the experienced driver was always able to cope with the disturbance and no lane exceedances or cone strikes were obtained.

Open-loop test results were highly repeatable. The most consistent indicator of vehicle degradation status was the instantaneous change in vehicle turn radius with deceleration. The maneuver induced significant decrease in turn radius (oversteer) with steer free play, low fluid rear shocks, worn A-arm bushings, and combinations of these degradations. Front brake imbalance resulted in a strong tendency to spin upon brake application in turns away from the degraded brake and a strong tendency to plow in turns into the degraded brake.

The brake-in-turn maneuver proved sensitive to snapthrough and quasi-linear type degradations, easy to perform, and highly repeatable (with a brake pedal actuator and steer input check chains).

F. Conclusions

Based on the final tests:

1. The brake-in-turn and bump-in-turn maneuvers appear well suited to vehicles-in-use sublimit handling performance tests and should be utilized in any future testing. Both are easily performed and produce repeatable, definitive measures of handling changes due to snapthrough and quasi-linear degradations. Both are particularly sensi-

tive to vehicle front and rear suspension and steering system degradations. The brake-in-turn maneuver aggravates, and therefore is particularly sensitive to, brake imbalance degradations.

2. The lane edge climb maneuver is also suited to tests for front and rear suspension and steering system degradation influence. However, this maneuver is more difficult to perform, is somewhat hazardous, and produces less repeatable results than do either of the above.
3. The low-frequency hump (straight or turning) traverse rapidly approaches a limit-performance maneuver and induces little change in vehicle handling at a sublimit performance level. It is not recommended for further testing.
4. The bump-on-hump maneuver is less informative than the hump-in-turn because it rapidly approaches a limit-performance situation in which influences of degraded components are contaminated by tire effects. It is not recommended for further testing.
5. The lane seam produced negligible side disturbance to the vehicle and provided essentially no differentiation of the various degradations. Tire characteristics appear to dominate in this maneuver. It may therefore be applicable to future tire testing.
6. The simulation and full-scale results are in fairly close agreement regarding the low-frequency (single) bump-in-turn maneuver. Diverse results were obtained for the simulated and full-scale lane seam maneuver because of the strong influence of tire contact patch deformation, which is not included in the simulation.

VI. MULTI-VEHICLE TEST PLAN

The ultimate goal of the vehicles-in-use handling investigation program is to establish maximum allowable degradation levels and inspection and/or test procedures that can be used in establishing motor vehicle safety standards. The specific objectives of the multi-vehicle test program are visualized as twofold:

- To validate, through a large vehicle sampling, applicability of the maneuvers and procedures developed to date for determining influence of vehicles-in-use steer, suspension, and brake

system degradation and tire factors on vehicle sublimit handling.

- To provide data which may be used to establish acceptable vehicles-in-use component degradation boundaries for motor vehicle safety and inspection standards.

Six maneuvers that exercise vehicle responses to driver steer and brake and roadway disturbance inputs are recommended. These are summarized in Table VI and detailed in Volume II. Five of these have been shown in the full-scale tests of this program to be simple, easily performed and sensitive to component degradations. The sixth maneuver (straight line braking) has been added for comparison with the brake-in-turn results and identification of load transfer influences. Each has high face validity regarding vehicles-in-use sublimit driving. Most are to be conducted open loop (programmed or frozen steer and brake inputs) to avoid compounding results with driver learning and variability. One (double lane change) is inherently a closed-loop control task, but it is constrained to approach open-loop performance.

The sampling of vehicles must provide the widest practical representation of steering and suspension system design, vehicle size, and oversteer/understeer variation encompassed by the majority of the current passenger automobile population. Table VII outlines the matrix of basic configurations recommended.

In order to achieve the natural "looseness" that comes with vehicle age and usage and thereby increase sensitivity to and/or influence of specific degradations

in steering, suspension, and brake systems, all test vehicles should be used rather than new. Each should have been driven approximately 30,000 miles (where possible) to be representative of the "average" vehicles-in-use as determined in reference 6.

New shocks (original-equipment or equivalent) and appropriately broken in radial tires should be installed. All suspension, steering, and brake system components must be inspected for excessive wear and adjusted or replaced as necessary to meet the manufacturers' recommendations for vehicles-in-use tolerance. All joints, bushings, gear boxes, etc., should then be calibrated for free play, and the systems calibrated for end-to-end free play, friction, and hysteresis. The resulting reworked and calibrated vehicles will serve as baseline for all further degraded component testing.

Key degradations to be tested individually and in combinations are indicated in Figure 1. Suggested means of implementation are presented in Appendix C of Volume II.

Because of the necessity for detecting and identifying threshold changes in handling parameters, high-grade instrumentation is required. It is recommended that the NHTSA instrumentation system developed under reference 24 be considered for these tests. This system has provision for all sprung and unsprung vehicle motion variables, individual wheel rpm, steer and brake inputs, etc., and has been designed for ease of transfer from one vehicle to another.

An automatic brake pedal force servo is recommended for all braking maneuvers to assure accurate, repeatable brake application.

TABLE VI
MULTI-VEHICLE TEST MANEUVERS

<i>Maneuver</i>	<i>Type</i>	<i>Purpose/Determine</i>
A Step steer	Open loop	Baseline stability factor (K) for each vehicle
B Double lane change	Closed loop	Stability and controllability under emergency (but sublimit) maneuvering
C Brake-in-turn	Open loop	Path stability under braking
D Straight line brake	Open loop	Path stability under braking
E Bump-in-turn	Open loop	Path stability/wander with vertical disturbance
F Turn exit	Open loop	Free steering returnability; vehicle convergence/divergence

A special device is also recommended for limiting the pressure in one front brake line in order to achieve and maintain desired braking imbalance levels.

Steering wheel check chains or similar displacement limiting devices are recommended for the step steer, brake-in-turn, and bump-in-turn maneuvers to obtain accurate, repeatable steer inputs.

TABLE VII
VEHICLE CONFIGURATIONS

<i>Configuration</i>	<i>Sedans</i>					<i>Sports Car</i>
	<i>Mini</i>	<i>Sub-Compact</i>	<i>Compact</i>	<i>Inter-mediate</i>	<i>Station Wagon</i>	
<i>Rear Axle</i>						
Solid						
Independent						
<i>Rear Suspension</i>						
Leaf spring						
Trailing link						
Torque arm						
Semi-trailing arm						
A-arm						
<i>Front Suspension</i>						
A-arm (unequal)						
McPherson						
<i>Steering System</i>						
Rack and pinion						
—powered						
—unpowered						
Conventional						
—unpowered						
—powered						
Kingpin offset						
—positive						
—negative						
<i>Brake System</i>						
Conventional front/rear proportioning						
Anti-lock						
<i>Drive System</i>						
Rear						
Front						
<i>Engine Location</i>						
Front						
Rear						

DEGRADATION		MANEUVER					
		A STEP STEER	B DOUBLE LANE CHANGE	C BRAKE IN TURN	D STRAIGHT LINE BRAKE	E BUMP IN TURN	F TURN EXIT
1	None original equipment	X	X	X	X	X	X
2	Steer freeplay		XX				
3	Front brake imbalance			XX	XX		
4	Low fluid shock-front	XX	XX	XX		XX	
5	Low fluid shock-rear	XX	XX	XX		XX	
6	Worn bushing-front A arm	X	X	X	X		
7	Worn bushing-rear A arm	X	X	X	X		
8	Asymmetric caster						XX
9	Asymmetric camber						XX
10	Power steering belt		X				
11	2 + 4		X				
12	2 + 5		X				
13	2 + 6		X				
14	2 + 7		X				
15	3 + 2			X			
16	3 + 4			X			
17	3 + 5			X			
18	3 + 6			X	X		
19	3 + 7			X	X		
20	5 + 6	X	X	X		X	

X - One Degradation Level
XX - Two Degradation Levels

DEGRADATION AND MANEUVER TEST MATRIX

Figure 1

VII. CONCLUSIONS AND RECOMMENDATIONS

A. Sublimit Performance Maneuvers

One primary goal of this investigation has been to develop and validate a set of vehicle sublimit performance maneuvers suitable for conducting research into the effect of component degradations and tire factors on vehicle sublimit performance. This goal has been accomplished. Five sublimit performance test maneuvers have been found to be sensitive to vehicles-in-use type degradations in steering, suspension, and brake systems and to tire factors. These are:

- *Step Steer*—A test maneuver that is sensitive to all degradations and that provides a basic and direct measure of influences on vehicle stability factor (K).
- *Double Lane Change*—A maneuver that is sensitive to all degradations and that provides a measure of vehicle controllability and driver workload in precision path control at moderate to high lateral acceleration levels.
- *Turn Exit*—A maneuver that is sensitive to asymmetric alignment, bent frame, or any similar degradation that alters vehicle directional trim (produces steering pull).
- *Bump-in-Turn*—A maneuver that provides a sharp disturbance to the vehicle unsprung mass, exercises suspension and steer system degradations and provides a measure of vehicle path stability with roadway disturbance inputs.
- *Brake-in-Turn*—A maneuver that is sensitive to all degradations, in particular side-to-side brake imbalance, and that provides a measure of vehicle path stability under asymmetric normal loading and combined lateral/longitudinal acceleration.

All of these maneuvers are easily performed, have relatively simple performance measures, are definitive of vehicle degradation influences on sublimit performance, and produce highly repeatable results.

B. Simulation

A second primary goal has been to modify the NHTSA simulation to incorporate vehicles-in-use sublimit performance investigative capability. The simulation was modified to incorporate:

- Front wheel camber misadjustment.
- Looseness (free play) in unloaded ball joints.

- Individual specification or scaling of operating skid number for each wheel (provides means for simulating tire underinflation and side-to-side brake imbalance).
- Individual specification of coulomb friction levels, spring gradients, and shock absorber gradients for each wheel.
- Roadway/tire lateral disturbance effect arising from change in wheel-to-ground camber angle arising from contact patch tilt with respect to the horizontal.

All of the above modifications and maneuvers were exercised and validated via comparative simulations and full-scale tests of two passenger automobiles.

C. Vehicles-In-Use Degradation Influences

The Variable Steering Servo (VSS) vehicle and final test results produced considerable definitive information regarding the relative influences of various steering, suspension, and brake system degradations and tire factors on vehicle sublimit handling performance. The VSS tests are the first known direct measurements of the influence of such degradations on vehicle open-loop dynamic characteristics and on driver/vehicle closed-loop interaction. These VSS results show:

- Quasi-linear type steer and suspension system degradations have little influence on vehicle dynamic characteristics, even when carried to extreme degradation levels.
- The changes in such dynamic characteristics are generally below the driver's threshold of perception.
- Tire factors (load, wear, and inflation) influence vehicle static and dynamic stability to such an extent as to swamp most other degradation effects.

The overall test results also support previous findings which show front end alignment (toe, caster, camber) and ball joints to have negligible influence on vehicle dynamic characteristics and handling unless extreme degradations are employed. Even then, the influence is relatively small. Tie rod end play also appears to have little influence on vehicle handling.

The degradations which most influence vehicle handling and performance are:

- Brake imbalance
- Front suspension bushing free play

when they occur in combination.

D. Recommendations

It is recommended that the multi-vehicle test plan accomplished as the final goal in this program be implemented to refine further the maneuvers and procedures prescribed, to extend the current vehicle data base, and to initiate development of meaningful acceptability criteria for vehicles-in-use testing.

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18. D. T. McRuer, R. H. Klein, et al., *Automobile Controllability—Driver/Vehicle Response for Steering Control*. Vol. I: *Summary Report*. Vol. II: *Supporting Experimental Results*, DOT HS-801 407 and DOT HS-801 406, Feb. 1975.
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 23. Richard H. Klein, Walter A. Johnson, and Henry T. Szostak, *Influence of Roadway Disturbances on Vehicle Handling*. Vol. II: *Technical Report*, Systems Technology, Inc., TR-1069-1, Oct. 1976.
 24. Systems Technology, Inc., *Solid State Data Acquisition and Processing System*, June 1975.

ABSTRACT CITATIONS

SAMPLE ENTRIES

FORMAT OF ENTRIES IN HIGHWAY SAFETY LITERATURE

NHTSA accession number ----- HS-013 124

Title of document ----- **MAXIMUM BRAKE PEDAL FORCES PRODUCED BY MALE AND FEMALE DRIVERS**

Abstract ----- The object of this research was to obtain data concerning the maximum amount of brake pedal force that automobile drivers were able to sustain over a period of ten seconds. Subjects were told to apply the brakes in the test car as they would in a panic stop, and to exert as much force as possible on the pedal over the entire ten second test period. A total of 84 subjects were tested, including 42 males and 42 females. The results indicated that there is a wide distribution of values which characterizes the pedal force that the subjects were able to generate. Male subjects produced generally higher forces than did females. Over half the women tested were unable to exert more than 150 lbs. of force with either foot alone, but when both feet were applied to the pedal, force levels rose significantly.

Personal author(s) ----- by C. R. VonBuseck

Corporate author (or author's affiliation) ----- General Motors Corp.

Publication date; pagination ----- 1973? ; 18p

Supplementary note ----- Excerpts from Maximum Parking Brake Forces Applied by Male and Female Drivers (EM-23) BY R. L. Bierley, 1965, are included.

Availability ----- Availability: Corporate author

NHTSA accession number ----- HS-018 924

Title of document ----- **NATURAL FREQUENCIES OF THE BIAS TIRE**

Abstract ----- The lowest natural frequencies of a bias tire under inflation pressure are deduced by assuming the bias tire as a composite structure of a bias-laminated, toroidal membrane shell and rigorously taking three displacement components into consideration. The point collocation method is used to solve a derived system of differential equations with variable coefficients. It is found that the lowest natural frequencies calculated for two kinds of bias tire agree well with the corresponding experimental results in a wide range of inflation pressures. Results of the approximate analysis show that the influence of the in-plane inertia forces on natural frequency may be considered small, but the influences of in-plane displacements are large, particularly on the natural frequency of the tire under low inflation pressure.

Personal author(s) ----- by Masami Hirano; Takashi Akasaka

Journal citation ----- Publ: Tire Science and Technology v4 n2 p86-114 (May 1976)

Publication date ----- 1976; 6refs

Availability ----- Availability: See publication

HS-025 856

CLAYBROOK 'CLARIFICATION' FAR FROM SATISFACTORY [MOTORCYCLE SAFETY EDUCATION]

A response is made to Joan Claybrook's letter to Lin Kuchler (American Motorcyclist Assoc.) on the position of the National Hwy. Traffic Safety Administration (NHTSA) on motorcycle safety education. Ms. Claybrook stated that NHTSA has assisted the Motorcycle Safety Foundation in curriculum specifications development, that a Federally-funded administrative feasibility test is being made in Colorado, and that NHTSA is providing money to states conducting rider education. Ms. Claybrook's position that motorcyclist education should not take place in high school because of its "enticement" effect is disputed, as well as her criterion of total accidents, injuries, and deaths for evaluating motorcycle education. The cost-effectiveness issue is also disputed, on the basis that the cited 60% of motorcycle education students who do not obtain licenses will be spared the risks of motorcycle driving and that these persons will be aware of motorcyclists' problems when driving automobiles. In a separate section, NHTSA allocations of funds for motorcycle safety are tabulated (1970-1977).

Publ: American Motorcyclist v33 n3 p18-9 (Apr 1979)
1979

Availability: See publication

HS-025 857

NOW THAT WINTER POTHOLES HAVE TAKEN THEIR TOLL...KNOW HOW TO CHECK YOUR FRONT END

Winter road damage in 1977-78 resulted in \$882 million in damage to tires, steering systems, suspensions, and brakes. Wheel alignment problems are explained, including those of caster, camber, toe, steering axis inclination, and turning radius; and methods of checking steering and suspension are outlined. Inspection and replacement of damaged front-end components can be done by the home mechanic, but alignment is best checked on professional equipment. Frequent examination of tires for abnormal wear is recommended to minimize misalignment problems.

by Mort Schultz

Publ: Popular Mechanics v151 n4 p116-8, 200 (Apr 1979)
1979

At head of title: Saturday Mechanic.
Availability: See publication

HS-025 858

FORGIVING APPURTENANCES SAVE LIVES [ROADSIDE SAFETY STRUCTURES]

An overview is presented of private sector involvement in the research and development of various highway safety appurtenances. This involvement was motivated by the realization that single-vehicle, run-off-the-road collisions with roadside obstacles constitute 33% to 40% of the total annual motor vehicle fatalities, or 12,000 to 18,000 deaths. Among the objects struck most often are trees, traffic railings, utility poles, bridge piers and abutments, and traffic signs and signals. Recent (since 1965) development in roadside appurtenances and operational procedures include fail-safe roadside breakaway and slip-base supports

for signs and luminaires, diagnostic safety procedures for assessing the roadside environment, a yielding and redirecting bridge rail, vehicle crash-attenuation devices, and various median barrier designs. Research by government and state organizations developed such improvements as longitudinal traffic barriers (guardrails and median barriers, the New York box beam, a strong beam-weak posts median barrier, and the New Jersey and General Motors shaped-concrete median barriers). Examples of frangible-type luminaire supports are aluminum shoe-mounted and shoe-base with riser, steel progressive shear, aluminum transformer base, high strength steel notched steel bolt inset, and aluminum fluted base supports. Federal Hwy. Administration-approved impact-attenuation types include steel drum and Hi-Dro Cell sandwich crash cushions, Fitch inertial barriers, Hi-Dri Cell sandwich crash cushions, Hi-Dro Cell cluster (for speeds up to 45 mph), and Guard Rail Energy Absorbing Terminal (G-R-E-A-T) with an adaptation for construction zones. To help solve the underride crash problem (automobiles into the back ends of moving trucks), various truck-mounted attenuators are being developed and tested.

by F. J. Tamanini

Publ: ITE Journal v48 n12 p20-5 (Dec 1978)
1978; 10refs

Availability: See publication

HS-025 859

AUTO SAFETY AND YOUR CHILD

Recommended crash-tested car restraints are described for children, from infants to children over 50 lbs in weight. The bucket type, backward-facing restraint is recommended for infants, a chair-type restraint with a 5-point harness for children up to 40 lbs who can sit up, and a 5-point harness attached to a floor bolt or to the rear window shelf for children from 15 to 50 lbs. A shield-type seat secured by an adult seat belt is also described. Proper use of child restraints is outlined, the importance of parental attitude is stressed, and common questions about restraints are answered.

Department of Health, Education, and Welfare, Washington, D.C. 20201

Rept. No. DHEW-(OHDS)-78-30123; 1978?; 16p 11refs
Availability: Corporate author

HS-025 860

ANALYSIS OF ACCIDENT DATA AND HOURS OF SERVICE OF INTERSTATE COMMERCIAL MOTOR VEHICLE DRIVERS. FINAL REPORT

A total of 25,666 single- and two-driver accidents and 483 bus accidents, occurring during 1976, was analyzed with data from the Motor Carrier Accident Report Forms (50T and 50B) and a special supplementary driver service and rest report form. A limited volume of driver exposure data was available for comparative analysis. The topics covered include: the hours of service regulations; driving, duty fatigue and accidents occurring between periods of extended rest; rest and the use of a sleeper berth; driver age, experience and physical condition; cyclic patterns; and carrier and vehicle characteristics. Supplementary data isolated the following types of accidents: ran-off-road, overturn, out-of-control, rear-end sideswipe (opposite), fixed-object, and driver-dozing condition. The two-man sample was much smaller than that of single-driver operation. The findings revealed no consistent pattern to indicate that the number of

driving hours alone was related to frequency or severity of accidents. An increase in accidents around the destination point was shown in both fatigue-related and other accidents. Drivers with accidents later in the trip tended to have at least a few hours of non-driving duty. Most drivers in accident cases were in compliance with present regulations on service and rest. Fatigue-classified accidents were proportionally higher at night (suggesting a circadian rhythm effect). Drivers under 40 years old, especially those under 25, were overrepresented in the accident sample. The mean driving time from last extended rest to the accident (single driver) was 4.38 hr, and total time, including non-driving hours, was 9.82 hr. The mean distance from origin to the accident was 199 mi (single-man) and 612 mi (two-man); the mean anticipated distance from accident to destination was 325 mi (single-man) and 1263 mi (two-man).

by Kenneth D. Hackman; Emilie E. Larson; Allen E. Shinder
Genasys Corp., 1 Central Plaza, 11300 Rockville Pike,
Rockville, Md. 20852; Safety Management Inst., 7979 Old
Georgetown Rd., Bethesda, Md. 20014
Rept. No. PB-286 718; 1978; 68p 6refs
Rept. for Aug 1978. Sponsored by Bureau of Motor Carrier
Safety.
Availability: NTIS

HS-025 861

PERSONAL CHARACTERISTICS AND PATTERNS OF VEHICLE USAGE AMONG VAN AND PICK-UP DRIVERS IN MICHIGAN

A comprehensive analysis was undertaken of those who own and drive light vans, recreational vehicles and pickups, using an extensive disaggregate data set on the driving habits of motorists measured throughout Michigan during all of 1976. The data were derived from a survey conducted by the Michigan Dept. of State. Socioeconomic and household characteristics of all owners and users in the survey (up to about 1925 out of 7600 respondents) were examined, together with detailed descriptive statistics on the behavior of motorists actually using vans, recreational vehicles, or pickups on a designated recent trip day. It was found that the users and owners of these vehicles generate more travel than any other private vehicle-user class, and that this may be related to socioeconomic and geographical factors.

by Martin E. Lee
Michigan Dept. of State, Res. and Evaluation Div.
Rept. No. SAE-790379; 1979; 15p 10refs
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 26 Feb-2 Mar 1979. Sponsored in part by Michigan
Office of Hwy. Safety Planning under Dept. of Transportation/
NHTSA 402 program.
Availability: SAE

HS-025 862

AN IMPROVED RADAR ANTICOLLISION DEVICE

An automotive anticollision device, RAD-80, is described which uses pulsed radar and is controlled by a microprocessor. The radar and its control significantly reduce false target response, loss of braking due to multi-path signal cancellation, and blinding from other radar-equipped vehicles. Increased range with reduced false target response allows warning of an impending collision and effective automatic braking. RAD-80's components include an antenna box mounted on the vehicle center line in front, containing a radome, phased array antennas R.F. assembly, I.F. amplifier, and second detector; a speed sensor and a brake sensor, both providing input to the microprocessor, mounted in the passenger compartment and controlling the

radar; a control console, mounted near the driver, containing an on/off switch, road condition selector switch, warning buzzer, volume control, system monitoring lights, and a nine digit code keyboard; an accelerator trip actuator mounted on the accelerator linkage and releasing the accelerator; and a brake actuator, mounted near the brake pedal, consisting of a vacuum motor, solenoid control valve and linkage to the brake pedal. The operation of the device is described, including target discrimination, multipath cancellation, low probability of blinding (interference by other radar-equipped vehicles), control braking, self-testing, and antitheft (optional).

by John B. Flannery; John C. Sims, Jr.; Snelling R. Brainard;
Leon Ruderman
Collision Avoidance Systems
Rept. No. SAE-790456; 1979; 10p 16refs
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 863

RELATIONSHIP BETWEEN ROADSIDE SIGNS AND TRAFFIC ACCIDENTS: A FIELD INVESTIGATION

The relationship between traffic accidents and signs located near urban traffic intersections was investigated at 60 randomly selected intersections in Austin, Texas which had had from one to 29 accidents in 1975. The sample was restricted to 90-degree intersections of two streets with a traffic count of 5000-30,000 vehicles/day. The number of at-fault accidents attributed to drivers approaching from each direction was computed, excluding night accidents and those unrelated to distraction. Observable signs at each intersection were classified by size, type, and dominant color. While results indicate that signs pose no traffic safety problem at intersections controlled by traffic signals, there is evidence that signs are related to accidents at stop sign controlled intersections, especially large commercial signs. Appropriate legislation is recommended to control the number and size of commercial signs located near stop signs. Alternative suggestions include designing larger or brighter target traffic devices, using neutral background shields, or substituting traffic signals for signs in areas where distracting signs are present.

by Charles J. Holahan
University of Texas at Austin, Council for Advanced
Transportation Studies, Austin, Tex. 78712
(77)-7200-02-B
Rept. No. CATS-RR-54; 1977; 26p 16refs
Prepared for the Texas Dept. of Highways and Public
Transportation, Office of Traffic Safety, Austin, Tex.
Availability: Corporate author

HS-025 864

A MULTIDIMENSIONAL PERCEPTUAL STUDY OF ROAD SAFETY

An analysis is presented of individual perceptual data obtained in an experimental setting. Wide angle movies were taken of 12 road segments and shown to three panels of licensed drivers (ordinary drivers, students in a traffic engineering course, and experts in traffic safety). Individual panel members rated each road segment on its accident-related characteristics. The evaluations were compared to actual accident data for the road segments using regression and scaling. Individual evaluations of road safety conditions were found to vary far more than individual perceptions of road characteristics. Individual differences scaling models indicated that both lexicographic and compensatory models could be used to represent perceptual differences.

HS-025 865

DISABLED DRIVERS HAVE MORE ACCIDENTS-- N.Y. STUDY. ALARMING STATISTICS?

Results are presented of a 3 1/2-year study by the New York Dept. of Motor Vehicles and the National Hwy. Traffic Safety Administration of 3336 disabled drivers (those who must use hand drive controls) and 120,934 able-bodied drivers. Accident variables studied included accident rate (number of accidents per driver), weather and roadway surface conditions, roadway character (i.e. straight, level), time of day, type, manner and location of accident, and other contributing factors. Disabled drivers were found to have a significantly higher accident rate than able-bodied drivers; accident rates decreased with age as in the general population, the highest rate being shown by males aged 16-24. It is suggested that driving environments of the disabled be compared to those of the able-bodied, since disabled persons tend to live in urban locations. It was also pointed out that drivers using hand controls have special problems due to inadequate equipment that are not faced by able-bodied drivers. More training in the use of hand controls is suggested. Further research is recommended on the reliability and durability of hand drive controls; on the comparison of the accident records of VA (Veterans Administration)-approved vs. non-VA-approved controls; on the relation of driving exposure to accident rate; on the effect of static vs. progressive handicaps on driving; and on the advisability of state inspection of hand drive controls.

Publ: Accident on Living p44-5 (Spring 1979)
1979

Based on a report by Richard Ibison and D. Barry Negri.
Availability: See publication

HS-025 866

A DISAGGREGATE MODEL OF AUTO-TYPE CHOICE

A multinomial logit model for the type of car that households will choose to buy is presented, which includes a large variety of auto characteristics as explanatory variables, as well as many characteristics of the household and the driving environment. The model is based on a stratified random sample of 1976-model new-car buyers. The model is restricted to new-car buyers and to classes, rather than makes and models, of automobiles. To examine the effect of auto weight on choice probabilities, a weight-age interaction term and one for weight-education were introduced, both in non-linear form. Auto purchase price, but not operating cost, was divided by income to indicate the importance of auto cost at various income levels. Problems in applying the model are outlined. Further research in using the model for exploring alternative policy scenarios has yielded preliminary results of the effects of a 10% gasoline tax, and of a 10% excise tax on the purchase price of Class 7-10 automobiles.

by Charles A. Lave; Kenneth Train
Publ: Transportation Research v13A n1 p1-9 (Feb 1979)
1979; 12refs
Sponsored by the Dept. of Energy.
Availability: See publication

THE CLEAN AIR ACT AMENDMENTS AND MOTOR VEHICLE INSPECTION/MAINTENANCE

Seven Inspection/Maintenance (I/M) programs are now in operation to identify vehicles which need remedial maintenance to improve emission levels and to assure that required maintenance is correctly performed. In areas exceeding the National Ambient Air Quality Standards, states and local areas are required to develop State Implementation Plan (SIP) revisions in order to attain these standards by 1982, with possible extension until 1987 if the SIP includes I/M. Environmental Protection Agency (EPA) studies have shown that maladjustments and poor maintenance, as well as tampering and use of leaded fuel in catalyst-equipped vehicles, have prevented realization of the full potential of vehicle emission controls. EPA's newest study in Portland, Oregon supports previous analysis of I/M's effectiveness, including a potential reduction of hydrocarbons and carbon monoxide by 25% to 30% from the inspected fleet. Among the states implementing I/M programs are New Jersey, Rhode Island, Nevada, Arizona, Oregon, and California. Public acceptance of I/M programs has been high. An effective I/M program is an integral element in mobile source emission control. Engine parameter adjustment by automobile manufacturers is also an important factor in emission control.

by Michael P. Walsh
Publ: Journal of the Air Pollution Control Association v29 n3
p212-3 (Mar 1979)
1979; 1ref
At head of title: Insight from the policy makers
Availability: See publication

HS-025 868

RAILROAD GRADE CROSSING PASSIVE SIGNING STUDY--PHASE 2

The results are summarized of Phase 2 of a study to determine the effectiveness of new passive signing systems in warning drivers of potential hazards at railroad grade crossings. The results of Phase 1 indicated improved effectiveness for the new signs tested. Phase 2 results confirmed these findings, showing increased awareness of drivers at railroad crossings (increased percentage of head movements or looking for trains). Each new signing system consisted of an at-crossing crossbuck and an advanced warning sign differing in color and design. The following systems and the base system were tested in Phase 2: System 1, a red and yellow advance warning sign and a white crossbuck superimposed on a circular red and yellow background with black border (the Texas system), judged most effective in Phase 1; System 2, a red and yellow advance warning sign and a yellow crossbuck with black border; and System 3, a red and yellow advance warning sign and a standard white crossbuck. Experiments were conducted at 18 sites in 14 states on two-way, two-lane rural roads of 1000 to 4000 average daily traffic and an average of two to four trains a day. All tests were conducted in one direction and only in good weather. Of the four types of analyses performed, only the two-way analysis of variance is discussed and tabulated here. System 1 showed significant improvement over the base system in terms of head movement, with the advance warning sign accounting for almost half of the improvement (as in System 3). Systems 2 and 3 were equally effective in terms of head movement. The base signs showed no significant differences in speed profiles compared to the base sign configuration under day or night conditions, nor were there significant differences in head movement improvement from site to site.

by Janet Coleman; Joseph S. Koziol, Jr.; Peter H. Mengert
Federal Hwy. Administration, Traffic Systems Div.;
Transportation Systems Center
Publ: Public Roads v42 n4 p128-35 (Mar 1979)
1979; 2refs
Availability: See publication

HS-025 869

EMERGENCY ESCAPE RAMPS FOR RUNAWAY HEAVY VEHICLES

The findings are summarized of the State-of-the-Practice Report on truck escape lanes developed by the Tennessee Dept. of Transportation for the Federal Hwy. Administration. The summary includes an example of the development of a truck escape ramp in southern Oregon. Three general categories of emergency escape ramps are described, including gravity type, arrester bed, and a combination of these two. Among the conditions to be met when designing and constructing an emergency escape ramp are sufficient available space, sufficient ramp length or an impact attenuator, an arrester bed wide enough for more than one vehicle, advance notice and well-marked access, good drainage to avoid ice, prevention of rolling backward to the highway, surfaced access for wreckers, advanced signing on dangerous grades to check brakes, delineated ramps to discourage inappropriate use, and a squared-off apron for arrester beds to maintain vehicle control.

by Earl C. Williams, Jr.; Harry B. Skinner; Jonathan N. Young
Tennessee Dept. of Transportation, Office of Res. and Planning;
Federal Hwy. Administration
Publ: Public Roads v42 n4 p142-7 (Mar 1979)
1979; 2refs
Summary of Federal Hwy. Administration Rept. HDV-21.
Availability: See publication

HS-025 870

ROADWAY LIGHTING HANDBOOK

The handbook is designed as a guide in planning, design, operation, and maintenance of roadway lighting systems. The steps in the overall process of designing and operating such systems include understanding visibility requirements, analyzing lighting needs, selecting lighting equipment and the lighting system configuration, designing the lighting system and hardware, operating and maintaining the system, and analyzing the economics of the lighting system. Warrants governing the use of continuous freeway lighting are presented, but it is noted that due to rising energy costs, the Federal Hwy. Administration does not encourage their use unless there are no practical alternatives. A bibliography and a glossary are provided.

by Ned E. Walton, ed.; Neilon J. Rowan; John M. Mounce;
Donald A. Anderson; Anton Huber; William L. Williams
Texas A and M Univ., Texas Transportation Inst.; Federal
Hwy. Administration, Washington, D.C. 20590
Rept. No. Implementation-Package-78-15; 1978; 256p refs
Availability: GPO, stock no. 050-003-00339-5

HS-025 871

COMPOSITES--HOW THEY'LL MAKE CARS LIGHTER, STRONGER

New techniques "knit" materials together to form composites: superstrong, lightweight substitutes for present components. Possible weight reduction by use of "graphite" composites is

tabulated for representative automobile components, such as hood, door, hinges, suspension arms, transmission support, and drive shaft. Composites under study for use in automobiles are generally made of fine, high-strength strands of carbon embedded in a plastic bonding material. Most carbon comes from polyacrylonitrile (PAN), heated under tension in air to oxidize and stabilize its structure and reheated without air, still under tension, at 1200-1600 degrees C to drive off the noncarbon portion. The tension is vitally important to achieve strength in the fibers. Union Carbide processes common pitch as a source of carbon fiber. The pultrusion process by the Graftek Div. of Exxon Enterprises is described. Carbon materials are not equally strong in all directions, as is steel; the fibers must therefore be oriented to handle a given load. Connecting rods, pistons, push bars, drive shafts, and perhaps crankshafts may be made of composites; coil and leaf springs, valve springs and sway bars are also candidates. Problems in using composites include the difficulty of attaching fittings, temperature sensitivity (poor heat conducting), need for low-cost, highly-efficient production processes, and cost/benefit considerations.

by E. F. Lindsley
Publ: Popular Science v214 n4 p89-91 (Apr 1979)
1979; 1ref
Availability: See publication

HS-025 872

ENGINE KNOCK: HOW MUCH IS TOO MUCH?

Since government fuel-economy standards have constrained engine design to conform to a 91-octane fuel limit, there has been increased engine knock in new cars. Engine knock (ping, detonation, spark knock, fuel knock, carbon knock) is defined as a rapid, uncontrolled, spontaneous combustion of the air-fuel mixture in part of the combustion chamber. Knock is due in part to the unleaded fuel requirements of the catalytic converter. Foreign cars appear to be relatively knock-free, due perhaps to high-revolution, lower-compression, small-bore engines. Some slowing of the knock problem in new American cars is accomplished by voluntary raising of octane level (92.7) by gasoline refiners, by production of "super unleaded" gasoline (96-97 octane), and by permission given by the Environmental Protection Agency to retard the timing of cars with knock problems. Ways of expressing octane ratings are described (Research method, Motor method). Major factors in knock are compression ratio (higher ratios provide more power and fuel economy, with a greater tendency to knock), and ignition timing (more advanced timing increases the likelihood of knocking). The complex combustion processes taking place in an engine are explained, including some of the factors that affect knock: altitude, atmospheric pressure, relative humidity, air temperature, characteristics of fuel and lubricating oil, spark timing, distributor advance curve, timing variation among cylinders, intake-manifold temperature, type of transmission, carburetor mixture, variations in mixture to individual cylinders, shape of the chamber, spark-plug location, and hot spots. Damage resulting from knock can occur due to high cylinder pressure, causing heat loss to surrounding components and distortion, even melting. Some experts say that very light knock indicates that the engine is adjusted for best fuel economy, but high-speed knock, at normal turnpike speeds, is usually masked by other normal noises (engine, wind). This type of knock leads to shorter engine life and increased octane requirement due to accumulation of deposits from unleaded fuel on the engine which are impossible to remove without tearing down the engine. Alcohol-gasoline mixtures present further problems.

by Ed Jacobs
 Publ: Popular Science v214 n4 p100-2, 150-1 (Apr 1979)
 1979
 Availability: See publication

HS-025 873

SPOT CAR PROBLEMS EARLY WITH A FINGERS-AND-FLASHLIGHT INSPECTION

The automobile owner who is not a mechanic is advised to "thump, tap, shake, and tug; listen, look, and feel" in order to prevent the most common on-the-road failures: sudden cooling system blow-up; fan, alternator and power steering failures; brake line failure under sudden stress; and falling exhaust pipe. Among the warning signs are oiliness, wetness, stickiness, and rough, dented, or worn spots. Parts should not rattle or rub against something else. This type of inspection should cover both the top and the bottom of the vehicle. Among the items covered by a bottom inspection are the muffler, hydraulic brake lines, and gasoline line. Top inspection items include air cleaner and tubes, heater and radiator hoses, gas lines, wiper connections and power steering hoses. Precautions for safety are outlined (wait for engine to cool; remove ignition key; remove or cover rings and wristwatch; don't smoke). Incipient failures of the water pump seal, leaking valve cover gaskets, leaking front or rear engine seal, or defective pan gasket, and leaking automatic transmission can be detected. Belts for water pump, alternator, power steering pump and air conditioner should also be checked in a top inspection. The trunk should also be inspected for loose rear light wires and sockets. Tire pressures and indications of wear should be included in the inspection.

by E. F. Lindsley
 Publ: Popular Science v214 n4 p110-1, 146 (Apr 1979)
 1979
 Availability: See publication

HS-025 874

CENTRALIZED LUBRICATION SYSTEMS FOR COMMERCIAL VEHICLES

The history of chassis lubrication is presented, including the evolution of the oil pump from foot-operated models through the development of automatic pumps. The first mileage controlled fully automatic system was designed for a tank transporter. A pump linked to the air brake is still favored for London Transport buses. Among the pump systems in current use are multi-line systems, single line resistance systems, and single-line positive displacement (specifications tabulated) systems. Design and application of chassis lubrication systems are described, including lubricant type (oil viscosity, grease, NGLI rating), lubricant quantity (tabulated), frequency of lubrication, lubrication pressure, and bearing design. Also discussed are system accuracy and repeatability, system reliability (operating conditions, self-priming, installation techniques, lubricant reservoir, and system monitoring devices). The benefits of automatic chassis lubrication are outlined: triple life of chassis bearings, lowered cost of MOT tests, easier dismantling of chassis parts, manual greasing limited to universal joint, and improvement in driver safety and comfort (i.e. easier steering). Examples of these benefits are cited. Future prospects are for increased use of automatic chassis lubrication systems, due to increased labor costs and demand for longer life for heavy vehicles, unless a "sealed for life" chassis bearing is developed. Automatic systems are used for over 50% of heavy vehicles and buses only in the U.K. and Japan. The main advantages in the future will be in reliability and cost reduction, especially of installation. Reliable

but inexpensive electronic warning systems are needed to ensure that sufficient lubricant is reaching the bearings; currently available warning systems are too expensive.

by P. G. F. Seldon
 Publ: Proceedings of the Institution of Mechanical Engineers
 v192 p325-32 (Dec 1978)
 1978

Tribology Group Chairman's address, prepared for presentation at Ordinary Meeting of Institution of Mechanical Engineers. London, 4 Oct 1978.
 Availability: See publication

HS-025 875

BRAKE TEST DYNAMOMETER PROGRAMMING

Development is discussed of a suitable control system for a fully programmable brake dynamometer with a high degree of test replicability. Such development eliminates the shortcomings arising from traditional, repetitive testing, which would not occur under normal service conditions. These problems include asymptotic changes over time in the coefficient of friction as films or resin build up on the lining surface, as special conditions arise on the cast iron mating surface, and as equilibrium conditions are set up between the chemical changes at the lining-metal interface and the process of wear. The present procedure, in contrast to repetitive testing, adopts continuously changing conditions in line (pressure) with those continuously changing conditions to which the brake is subjected (temperature, duration, cooling, torque). Recording of all simulated brake applications results in a complete picture of the frictional behavior of materials for disc brakes and large commercial drum brakes. Experimental design focused upon simulation of brake temperatures under heavy, moderate, and light usage conditions. Baseline temperature, brake pressure, and cooling parameters were established through actual roadtests. To program a sequence of appropriate temperatures into the control system of a dynamometer, the moderate duty temperature was etched onto a printed circuit board which was then placed with the time axis horizontal and parallel to the X axis of an X-Y plotter. Temperature signals from a thermocouple bearing on the disk surface were fed to the Y axis. A post office type uniselector was used to program application speed, release speed, and brake pressure. Based on roadtest observations, a constant line pressure of 13.79 bars (200 lb ft/sq. in.) was selected for the majority of tests. A full size test rig was employed. Comparison of test results has shown a high degree of repeatability; standard deviations between tests for wear and for coefficient of friction are 0.0005 mm and 0.003 mm respectively.

by D. Hatch; M. W. Moore
 Publ: Proceedings of the Institution of Mechanical Engineers
 v192 p377-85 (Dec 1978)
 1978; 8refs

For presentation at Ordinary Meeting of the Automobile Div., London, 14 Nov 1978.
 Availability: See publication

HS-025 876

DRIVING STINED [SIC], STUNNED, STONED [MARIJUANA USE AND DRIVING]

Results are cited for various research studies on the effects of marijuana on perception, attention, and tracking ability (as part of the driving task). It has been clearly indicated that marijuana does impair visual perceptual performance to a large degree and potential users should be warned that it is likely to lead to accidents. A statistically significant impairment in color discrim-

ination following marijuana intoxication has been found (practical implications for perception of traffic signals). Results of one study suggest that under the influence of marijuana, tasks that require sustained attention will suffer initial impairment, followed by further decline over time. A survey of research on marijuana showed considerable evidence of a performance decrement under marijuana when the subject is faced with stimuli which demand constant attention, which appear at random, unexpected intervals, or which require additional central processing such as storage and retrieval; detection of intermittent random signals in central and/or peripheral vision is also impaired, as is recognition of previously presented material. The literature survey revealed that performance decrements on pursuit tracking tasks (i.e. following lane markers, other cars, etc.) have been found beginning at 5 mg THC (tetrahydrocannabinols, the active ingredient in marijuana) per kg body weight. Peripheral vision has been found to be impaired progressively by increasing doses of marijuana. Visual autokinesis motion has been shown to increase substantially with the use of marijuana, the increase being dose-dependent; the implication of this finding is that hazards are involved in operating vehicles at night while under the influence of the drug. The results of a particular study of the effects of marijuana in real driving situations indicated that driving under the influence of marijuana should be avoided as carefully as driving under the influence of alcohol.

by Jeri E. Rood

Publ: Driver v12 n9 p0, 1, 3-8 (Feb 1979)

1979; 17refs

Availability: See publication

HS-025 877

IN YOUR TRUNK WITH A LOAD OF JUNK. [EMERGENCY ITEMS TO BE CARRIED INSIDE CAR TRUNK]

A list is provided of emergency supplies and better replacement items for standard equipment to put in a car's trunk. Either a scissors-type or a hydraulic jack is recommended as safer than the usual bumper jack. With a bumper jack, blocks of wood to wedge under tires are a necessary trunk item. A good four-way lug wrench is also a good replacement item. The following fluids should go in the trunk: a can or two of motor oil, a can of brake fluid, and a container of automatic transmission fluid (if relevant). The minimum basic tools for quick repair jobs required are a pair of pliers, an adjustable wrench, and several different-sized screwdrivers. A roll of silver duct tape and a length of some kind of wire (e.g. 10- or 12-gauge) should also be carried. For illumination purposes, a trouble light that hooks into the cigarette lighter or a simple flashlight, and some signal flares or bright reflectors are needed. Jumper cables are recommended. Extra parts to carry include a fanbelt and windshield wiper blades. Snowbelt items include an ice scraper (one with brush on end of handle), a shovel, and kitty litter (preferable over sand or salt). Two useful items are tread and pressure gauges. One final item is a first-aid kit. It is advised not to carry a fire extinguisher in the trunk, but to mount it under the dash on passenger's side for easier access.

Publ: Driver v12 n9 p10-2 (Feb 1979)

1979

Availability: See publication

HS-025 878

DETROIT'S NEW/OLD ANSWER TO THE GAS MILEAGE PROBLEM. [TURBOCHARGING]

Turbocharging is helping U.S. automakers solve the "mileage vs. power" problem because of its ability to extract maximum power from small, fuel-efficient engines. Turbocharging is simply the process of using otherwise wasted exhaust gas to run a small air pump. A turbine wheel is installed in the exhaust system and is connected by a shaft to an impeller (compressor) mounted near the carburetor. As the engine speeds up, the impeller speed increases and creates a positive air pressure against the cylinders so that when the intake valves open, an air/fuel mixture is forced into the cylinder (i.e. "charging" the cylinder), making more power. In order to prevent the boost from becoming too high in this self-perpetuating cycle, an exhaust valve is used to bypass some of the exhaust gases around the turbine at a predetermined pressure. Because the turbo shaft spins at high speed and is subjected to exhaust-gas high temperatures, it needs a good oil supply to maintain its bearings (suggested oil and filter change every 3000 mi). The engine is the source of this oil, and most turbocharged production cars have a warning light or audible signal to indicate dangerous engine oil temperature/pressure levels. In order to prevent engine damage due to knock, some turbo-equipped engines use sensors located in, or near the intake manifold, to sense knock and signal a control module to retard ignition timing. Other retard mechanisms are triggered by specific boost levels. Because of higher cylinder head loads and stresses with turbocharging, most engines require some modification (e.g. replacement of head gasket, main and rod bearings, oil and water pumps, and radiator, with heavy-duty or competition-rate parts).

Publ: Driver v12 n9 p14-20 (Feb 1979)

1979

Availability: See publication

HS-025 879

THE HOW AND WHY OF FILTERS [CAR FILTERS]

Procedures for servicing (either cleaning or changing) various automobile filters are provided for the car owner. Step-by-step instructions (and accompanying photographs) are given for changing oil filters (cannister or spin-on units), a routine maintenance procedure recommended for each oil change. Information is also given for cartridge-type oil filter units which are found on some imported cars and older GM products. The air filter change is usually just a matter of removing the filter and slipping in a new one. For changing air filters in cars equipped with fuel injection or turbochargers, reference to an owner's manual is suggested. Methods are mentioned for servicing cleanable foam air filters, found on a small minority of cars. The various types of gasoline filters are pictured and procedures for their replacement outlined. Three types currently in use include an element type mounted in or on the fuel pump, a small plug of sintered bronze or pleated paper that fits into the carburetor fuel inlet boss, and an in-line filter that mounts between the fuel pump and the carburetor.

Publ: Driver v12 n9 p22-7 (Feb 1979)

1979

At head of title: The Backyard Mechanic, Back to Basics.

Availability: See publication

HS-025 880

BEYOND TELEDRAULICS [MOTORCYCLE FRONT SUSPENSION/STEERING UNIT DESIGN]

Alternative approaches to the telescopic fork in the design of the motorcycle front end are explained. Different avenues being explored in both on-road and off-road applications include link-type forks, floating front brakes, wing arms with center-hub steering, and parallel-link systems. Designers are seeking better ways to perform the two basic functions of a motorcycle front end: location/pointing and suspension/compliance (which translate into precise control combined with stability). Location/pointing is the steering function; it involves pointing the front wheel in the desired direction and keeping it precisely oriented. Suspension/compliance is a catchall for springing, damping, and travel.

by Lane Campbell

Publ: Cycle World v18 n4 p73, 76-9 (Apr 1979)

1979; 1ref

Availability: See publication

HS-025 881

STUDIES OF SEAT BELT PRELOAD DEVICES (UNTERSUCHUNGEN MIT SICHERHEITSGURTSTRAFFERN)

The results are presented of comparative studies by Ford-Werke A.G., Cologne-Merkenich, of seat belt preload devices which pull the safety belt tight in the event of a crash. There are linearly and radially operating preload devices, actuated by a signal from a crash sensor. The gas pressure from a cartridge actuates a piston or turbine which tightens the seat belt within 25 milliseconds of a crash. Test results showed that the position of the preload device affects its performance, and that seat design has a crucial effect on occupant displacement. The linear preload device on the outer lap belt restrained the pelvic area but allowed a 420 mm forward head movement, reduced by 50 mm with a locking B-pillar loop. Deceleration was reduced by 10 g for the chest and 20 g for the head, compared to belts without preload devices. The radial preload device in the inertia reel provided better chest restraint but allowed more pelvic displacement (120 mm forward pelvic movement, 370 mm head movement; maximum deceleration of 50 g for the head, and 33 g for the chest). The occupant's position relative to the B-pillar loop was found to be important; a B-pillar position in front of the occupant's chest (as in four-door cars) allowed forward movement even with a tightened belt. Sierra 1050 dummies were used for all tests. The sled deceleration curve was in line with ECE-R16 (Economic Commission for Europe) requirements. A separate note announces an air cushion transport system by British Hovercraft Corp., Ltd. for heavy loads, consisting of a flexible apron, air feed unit, air lines, and control.

by Heinz Grittner

Publ: ATZ Automobiltechnische Zeitschrift v81 n1 p17-8, 23 (1979)

1979; 12p

Translated from German (original 3p; translation 9p).

Availability: Reference copy only

HS-025 882

THE TOLERANCE CAPACITY OF THE HUMAN HEAD FOR ROTATIONAL ACCELERATIONS (ZUR ERTRAGLICHKEIT VON ROTATIONSBESCHLEUNIGUNGEN DES MENSCHLICHEN KOPFES)

The significance of rotational acceleration of the head as a cause of injuries in impact accidents of car occupants wearing seat belts was studied at the Battelle Inst., Frankfurt am Main, by comparing known tolerance limits with the results of sled tests using dummies. Of the three theories of the mechanism of brain injury (pressure gradient inside the skull with cavitation at the antipole of the shock; pulling or tearing of the veins in the pons; deformation of the skull with or without fracture, and rotation of the brain mass with tangential stress to blood vessels), the third theory best corresponds to clinical and experimental observations, and also explains the occurrence of widespread brain injury. It is shown that injuries of the brain most probably do not occur in an impact accident at 50 km/h if the head does not strike against any part of the passenger compartment. This is not true, however, if the head comes into contact with a vehicle part or rebounds against the head rest. Unfavorable kinematics of forward displacement of the body, e.g. submarining which results in increased rebounding, must therefore be absolutely avoided. This requires an optimum geometry and capacity of the safety belt, good seat construction (high back, inclined seat), and above all the wearing of the safety belt. Since head rebound cannot be eliminated with elastically-deformable seat belts, the shock-absorbing capacity of the headrest must be adequate. A separate note announces the development of soft foam for lining cabs of heavy construction equipment by AIREX A. G. of Switzerland.

by Gert Ruter; Heinrich Hontschik; Egbert Muller

Publ: ATZ Automobiltechnische Zeitschrift v81 n1 p25-7 (1979)

1979; 12p 7refs

Translated from German (original 3p; translation 9p).

Availability: Reference copy only

HS-025 883

THE DRIVER GUIDANCE AND INFORMATION SYSTEM (ALI). NEW POSSIBILITIES FOR TRAFFIC REGULATION ON HIGHWAYS AND MAJOR ARTERIES (DAS AUTOFÄHRER-LEIT- UND INFORMATIONSSYSTEM ALI. NEUE MOGLICHKEITEN DER VERKEHRSBEEINFLUSSUNG AUF AUTOBAHNEN UND SCHNELLSTRASSEN)

The Destination Guidance and Information System (ALI) provides the individual motorist with the ability (taking the actual traffic situation into consideration) to be guided to his destination by the optimum route and be quickly informed about obstructions caused by traffic and weather. In addition, this system provides the local traffic authorities with the knowledge not only of the flow of traffic on the selected routes, but also the desired destination of the ALI vehicles. With this information better predictions can be made for the regulation of the flow of vehicles and prevention of overload of certain routes. Three types of devices, located on the vehicle (transmitter, receiver and control unit, with display panel and driver input), on the road (induction loops), and in the control centers (computer), are used to exchange information between vehicles and fixed ground sites. The costs are relatively low, especially due to the fact that existing equipment for traffic data collection can be incorporated into this system. It is estimated that in mass pro-

duction the vehicle unit would cost approximately as much as an automobile radio. At the moment a large-scale test is being prepared in the Ruhr area (Germany), the results of which will be available by the end of 1980. A separate note announces a new automated production system for Triplex "Ten-Twenty" compound windshield glass, which reduces the danger of lacerations in an accident.

by Klaus Ottenroth

Publ: ATZ Automobiltechnische Zeitschrift v81 n1 p3-7 (1979) 1979; 19p 5refs

Translated from German (original 5p; translation 14p).

Availability: Reference copy only

HS-025 884

NATIONAL INSTITUTE OF DRUG ABUSE RESEARCH SERIES. DRUG USERS AND DRIVING BEHAVIORS

Summaries of the latest research on the interactions between drugs and driving behaviors (76 citations) are provided, categorized as review, experimental, or epidemiological in nature. A list of the citations is provided, arranged alphabetically by author; the summaries are similarly arranged in each of the three sections. A supplementary bibliography of additional readings, and a set of indexes (drugs, geographic locators, institutions, instruments, investigators, sample types, subjects) are included. The experimental studies, comprising the largest section, deal with the effects of drugs on cognition, coordination, reaction time, and other psychomotor functions; they include driving-simulator and real-driving situations. The epidemiological studies deal primarily with investigations of drug-involved motor vehicle accidents. The documents were published between 1960 and Dec 1976, with the exception of certain older "classic" studies which merited inclusion, and unpublished dissertations. The studies are in English, and focus on American drug issues.

by Gregory A. Austin, ed.; Robert S. Sterling-Smith, ed.; Mary A. Macari, ed.; Dan J. Lettieri, ed.

Documentation Associates Information Services Inc., 11720 W. Pico Blvd., Los Angeles, Calif. 90064

PHS-HSM-271-75-3071

Rept. No. PB-286 823; NIDA/RD-78/020; 1977; 181p 158refs

National Inst. on Drug Abuse Res. Issues Series-20.

Availability: NTIS; GPO, stock no. 017-024-00640-8

HS-025 885

DRIVER ANTHROPOMETRY AND VEHICLE DESIGN CHARACTERISTICS RELATED TO SEAT POSITIONS SELECTED UNDER DRIVING AND NON-DRIVING CONDITIONS

A sample population of 51 male and 57 female subjects from 18 to 78 years of age was tested in six different vehicles (Dodge van, GM van, Pontiac LeMans, Ford Fairmont, Ford Fiesta, and VW Rabbit) for preferred seat positions under static and dynamic conditions. Volunteer subjects were selected by age, stature, and weight criteria in order to match as closely as possible the U.S. adult population. Preliminary analyses of the data suggest that on a total sample basis there is less than a half inch in mean difference between seat positions selected under nondriving and driving conditions, but that individuals may show significant differences. The small differences in group mean positions observed may be due to a seat belt and/or an initial seat position factor. The tendency is for people to select positions closer up when using seat belts or starting from an

initial forward position. Stature was found to be the most significant anthropometric variable in determining seat position, explaining approximately 30% to 60% of the seat position variance, depending on vehicle seating configuration. The relation between stature and seat position for the total population was found to be nonlinear. A linear regression of mid-range stature and seat position underestimated the close-up and far-back positions selected by population extremes. A complex interaction between pedal location and steering wheel location in determining preferred seat position was observed, based on a comparison of dimensionalized mean seat positions selected across the six vehicles.

by Lawrence W. Schneider; Charles K. Anderson; Paul L. Olson

University of Michigan, Hwy. Safety Res. Inst.

Rept. No. SAE-790384; 1979; 19p 9refs

Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979. Research sponsored by Motor Vehicle Manufacturers Assoc.

Availability: SAE

HS-025 886

TRANSPORTATION ENERGY CONSERVATION DATA BOOK. 3RD ED.

Baseline data on the determinants of energy use in the transportation sector are provided in order to identify potential areas for energy resource conservation and to project future levels of energy use. Secondary data on transportation characteristics by mode, on transportation energy use, and on other related variables are presented in tabular and/or graphic form. All major modes of transportation are represented: highway, air, rail, marine, and pipeline. The six main chapters focus on various characteristics of the transportation sector, including modal characteristics; current energy use, efficiency, and conservation; projections of modal energy use; impact of government activities; supply and cost of energy; and general demographic and economic characteristics. Included in the more than 400 tables and figures are the following transportation stock and use statistics: number of vehicles, vehicle-miles traveled, passenger-miles and freight ton-miles, fleet characteristics, household automobile ownership, size mix of automobiles, vehicle travel characteristics, and commuting patterns. Energy characteristics presented include energy use by fuel source and transportation mode, energy intensity figures by mode, indirect energy use, production as a percent of consumption, imports as a percent of domestic production, energy prices from the wellhead to the retail outlet, and alternative fuels.

by Debby B. Shonka, ed.

Oak Ridge National Lab., Transportation Energy Prog., P.O.

Box X, Oak Ridge, Tenn. 37830

W-7405-eng-26

Rept. No. ORNL-5493-Special; 1979; 521p refs

Edition 3 of ORNL-5198.

Availability: NTIS \$16.50 printed copy, \$3.00 microfiche

HS-025 887

YOU LIGHT UP MY LIFE [QUARTZ HALOGEN HEADLIGHTS]

Quartz halogen lamps are expected to replace conventional sealed beam lamps in automotive headlights, since the Dept. of Transportation has authorized a doubling of the maximum permissible high-beam candlepower output from 75,000 cd to 15,000 cd, effective with the 1979 model year cars. Many of the new lamps will use halogen low beams as well. The quartz

halogen headlight uses a halogen capsule inside a conventional sealed beam unit, creating, in effect, a bulb within a bulb. Halogen vapor combines with the particles of condensed tungsten, and through a series of chemical reactions, redeposits the tungsten back onto the filament, preventing the bulb from blackening. The halogen gas makes it possible to burn the filament at a higher temperature, providing more light and a whiter color. The American version of the quartz halogen headlamp differs from its European counterpart in construction and beam pattern. The European styles are composite; they use a separate bulb and reflector behind a glass lens. The American sealed-beam construction has the advantage of being a completely fixed optical system; the filament or the halogen inner bulb is permanently positioned in proper relation to the lens, reflector, and aiming pads. The European low-beam pattern has a sharp cutoff on the left and a flare to the right. When correctly aimed, no light is supposed to extend above the car's hood, and there is an even distribution of light on the road. The American low-beam pattern shoots more light down the center of the road and provides greater seeing distance. A portion of the beam extends upward, making overhead signs more readable. Each beam pattern has its advantages and disadvantages.

by Cliff Gromer

Publ: Motor v150 n3 p43-6 (Mar 1979)

1979

Availability: See publication

HS-025 888

RECENT TRENDS IN VAN AND SMALL TRUCK SAFETY

An analysis is made of the safety record of pickup trucks and vans in the U.S. to compare their accident experience with that of the rest of the vehicle population. There has been a dramatic increase in the use of pickups and vans, which have been exempt from many of the safety regulations governing the production of passenger cars. Data obtained mainly from the 1977 Fatal Accident Reporting System (FARS) indicate that vans and pickups are not demonstrably less safe than passenger cars. Compared to passenger cars, pickups have a considerably higher accident involvement rate but only a slightly higher fatality rate, and vans, which have about the same involvement rate as passenger cars, have a lower fatality rate. A rather surprising finding is that vans and pickups perform somewhat better than passenger cars on a scale designed to reflect gross safety aspects (safety experience by weight ratio for two-vehicle collisions). It cannot be determined whether this better performance is due to the inherent safety of these vehicles or to their hostility with respect to the other vehicles with which they collide. Vans appear to be disproportionately involved in pedestrian and bicycle accidents (related to their greater use in densely-populated urban areas), and pickups seem overrepresented in rollover accidents (related to greater use in rural areas with bad roads).

by James O'Day; Richard Kaplan

University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich.

Rept. No. SAE-790378; 1979; 8p 3refs

Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.

Availability: SAE

HS-025 889

CASE-CONTROL STUDY OF RECIDIVIST DRIVERS INVOLVED IN FATAL HIGHWAY ACCIDENTS IN ALBERTA IN 1970-72

A three-year epidemiological study of fatal motor vehicle accidents in Alberta (Canada) carried out by the Alberta Task Force on Hwy. Accidents showed that 11.1% of culpable drivers had been driving while impaired by alcohol on at least one occasion prior to the fatal accident, while only 3.3% of exonerated drivers had previous records. This significant difference led to a case-control study of drivers involved in fatal accidents which demonstrated that culpable recidivist drivers (case group) differed significantly in a number of aspects from innocent drivers without previous records (control group). The case group (82 persons) outnumbered the control group (101 persons) in the age group 20 to 44 and contained 11.5% more males. The case group had been drinking before the accident significantly more frequently than the control group. It was found that 73.6% more culpable drivers than innocent drivers had a blood alcohol concentration (BAC) of 80 mg/dl or more. The proportion of Indians and Metis in the case group was 15.1% greater than in the control group. The culpable drivers had significantly more so-called noncollisions (running off the road and overturning) than the innocent drivers. They also collided more frequently with motorcycles, trains, pedestrians, and fixed objects, and less frequently with other cars, than the controls. The case group had 23.6% more accidents in which the car ran off the road and overturned and 12.4% more sideswipe accidents than the control group. Of the 82 recidivist drivers, 47 survived; one of the surviving drivers caused two fatal accidents in one year which claimed the lives of three teenagers and one child.

by Gerda Bako; Walter C. Mackenzie; E. S. O. Smith

Publ: Canadian Medical Association Journal v116 p149-51 (22 Jan 1977)

1977; 3refs

Includes French summary.

Availability: See publication

HS-025 890

EFFECTS OF EXPERIENCE AND SHORT-TERM PRACTICE ON DRIVERS' EYE MOVEMENTS AND ERRORS IN SIMULATED DANGEROUS SITUATIONS

Two groups of 10 subjects (female college students) tracked a segment of the Aetna training film, Traffic Strategy, six times by manipulating the controls of an Aetna Drivo-Trainer station. One group was composed of licensed drivers, the other, of nonlicensed individuals. No significant differences were found between the two groups with respect to the use of the accelerator, frequency and length of eye movements, fixation or driving errors, or the relationship of control action to driving errors. Differences were noted with respect to steering and braking, the effects of practice on control actions and driving errors, and the relationship of amplitude of eye movement to control actions and driving errors. In general, the results suggest that eye-movement parameters related to the ease of stimulus reception are relatively insensitive to short-term practice gauged by driving errors. Evidence, however, suggests that the search patterns of experienced and inexperienced drivers are different. The mixture of correlations for the two groups may reflect the fact that while inexperienced drivers may employ rather indiscriminate search strategies, more experienced drivers tend to reduce redundancy by greater reliance on peripheral vision and the "chunking" of information from the driving scene. More defini-

tive conclusions might have been forthcoming had the method permitted an analysis of actual fixation-point differences between the two groups.

by John A. Allen; Stephen R. Schroeder; Patricia G. Ball
 Publ: Perceptual and Motor Skills v47 n3 p767-76 (Dec 1978)
 1978; 13refs
 Conducted as part of a larger project, "Driver License Road Testing," DI-69-001 (002), sponsored by North Carolina Governor's Hwy. Safety Office.
 Availability: See publication

HS-025 891

FLEXIBLE WORKING HOURS AND ITS EFFECT ON COMMUTING PATTERNS

Background is given on flexible working hours practice in state government offices, the Post Office, and private industry within Wellington City, New Zealand. By the end of 1976, it is estimated that approximately 13,000 of the 60,000 employees in the central area of Wellington were working on the flexible working hours system. An analysis was made of the effect on commuting patterns of the introduction of flexible working hours in two government departments in Wellington (Health Dept. and Inland Revenue Dept.). Two questionnaires were issued to staffs of the two departments, one on 27 Sep 1974 immediately prior to introduction of flexible working hours, the other on 24 Oct 1974. Information was requested on the mode(s) of transport used to and from work for a week, work start and finish times in the same week, and details on why the particular mode and start/finish times were chosen (follow-up questionnaire). It was found that the resulting shifts in working hours tended to decrease by 30% the number traveling back and forth to work at times when the roads were congested. A 15% increase in private transport (car drivers and passengers) at the expense of public transport (buses and trains) was also noted, as well as an 11% increase (not significant) in the total number of commuter trips made by car. Restricting the total amount of parking available to commuters in the city is recommended, as a method for limiting total private car travel.

by M. J. Jackett
 Ministry of Transport, Road Transport Div., Private Bag,
 Wellington, New Zealand
 Rept. No. TRR-19; 1978; 32p 3refs
 Availability: Corporate author
 1978; 41p 8refs
 Availability: Corporate author

HS-025 893

REPORTING THE HANDICAPPED DRIVER

Medical ethics and legal constraints today demand that physicians report to appropriate agencies the uncooperative, unsafe, newly-handicapped patient. The risk of being sued for permitting an unsafe driver to injure himself or society far outweighs the theoretical improbability of being sued for breach of doctor-patient confidentiality. No such cases of suit were found in a thorough search of the medical and legal literature. A practical method of managing this ethical/legal problem is proposed, taking into account the variabilities in state laws. A physician should counsel the patient and the patient's family knowledgeably. He should put his advice in writing and have the patient or a member of his family sign the document. The physician should try to refrain from prescribing medications that impair driving ability. He should report the uncooperative patient to the state by notifying only the specific authority with jurisdiction over driver licensing. The physician should include in his

report his basic diagnosis, laboratory findings, and verifiable incidents supporting his opinion that the patient is an unsafe driver.

by Stanley Jacobs
 Publ: Archives of Physical Medicine and Rehabilitation v59 p387-90 (Aug 1978)
 1978; 19refs
 Presented at 53rd Annual Session of American Congress of Rehabilitation Medicine, San Diego, 12 Nov 1976.
 Availability: See publication

HS-025 894

BLOOD ALCOHOL LEVELS. HOW ACCURATELY CAN THEY BE GUESSED?

Volunteers were asked to guess their blood alcohol level (BAL) immediately before having their venous level measured by gas chromatography. BAL readings ranged from zero to 295 mg/100 ml. Thirty-one percent of the 33 female and 128 male participants were able to guess to within 20 mg/100 ml of the measured amount. There was a tendency for people to overestimate if the levels were low and to underestimate the higher values. The results show that most people tested could not adequately judge their BAL and would be poorly prepared to decide whether or not they should drive, in terms of the New Zealand legal driving limit of 100 mg/100 ml.

by J. R. Sharman; T. N. Lindley; M. H. Abernethy
 Publ: New Zealand Medical Journal v87 p438-40 (28 Jun 1978)
 1978
 Availability: See publication

HS-025 920

1979 FIREBIRD - AN ADVANCED (PART 581) SOFT BUMPER SYSTEM

Weight and performance characteristics of the 1979 Pontiac Firebird soft bumper system are compared to those for a typical new (1979) metal/hydraulic design to evaluate the effects of the new standard. The study demonstrates the changing competitive environment in the automotive bumper market due to the introduction of the Part 581 Standard. The deep soft bumper concept is also discussed, including its potential for achieving weight reductions in future elastomeric bumper systems. Test results before and after revisions are provided, with diagrams and photographs. Development work is proceeding on the deep foam concept for future soft bumper designs, with the possibility of significant further weight reductions when such problems providing radiator clearance in a front bumper design have been solved.

by J. V. Scrivo
 Davidson Rubber Co., Inc.
 Rept. No. SAE-790335; 1979; 15p 5refs
 Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.
 Availability: SAE

HS-025 921

BUMPER ENERGY ATTENUATORS MADE FROM FIBER REINFORCED PLASTIC

A family of weight saving bumper energy management devices has been developed from continuous fiberglass composites which is able to replace the hydraulic impact attenuators currently

rently used between the bumper and the structure of automobiles. Various shaped moldings have shown the capability to pass the impact test requirements facing the passenger car market as posed by Federal Motor Vehicle Safety Standards 581. Among the more efficient units are those making use of the buckling column phenomena such as the "Y Column" and "Sigma Column" bumper energy attenuators. Projected weight savings on retrofitted vehicles range from 3.6 kg to 9.1 kg; designing a vehicle specifically for "Y" or Sigma columns could result in even greater weight savings. Through the use of multi-layers, deflections up to 10 cm can be sustained without any composite breakdown. Sigma and "Y" columns have undergone 20 consecutive 8.1 kph impacts without significant degradation of properties; operating characteristics of Sigma and "Y" columns vary by less than 5% when tested over the temperature range of -40 degrees C (-40 degrees F) up to 76.7 degrees C (170 degrees F). Exposure to oven bake temperatures of 190 degrees C (375 degrees F) for one hour resulted in no change in operating characteristics. In a simulated 48 kph (30 mph) collision, the "Y Column" attenuator did not fail catastrophically; it had enough strength to support the bumpers, and showed little or no velocity sensitivity.

by Malcolm K. McDougall; Joseph N. Epel; Robert E. Wilkinson
Budd Co., Plastic Res. and Devel. Center, Troy, Mich.
Rept. No. SAE-790334; 1979; 16p
Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979
Availability: SAE

HS-025 922

DESIGN AND MANUFACTURING GUIDELINES FOR ULTRA HIGH STRENGTH STEEL BUMPER REINFORCEMENT BEAMS

The weight of a bumper system with a plastic fascia is significantly affected by the weight of the bumper reinforcement beam. The design and manufacture are addressed of ultra high strength steel bumper reinforcements, and an example of a proven design is provided. Beam design to withstand the maximum bending moment without failure, deflecting no more than is allowable within the given bumper protection band, is discussed and presented in equations. Test results demonstrate the effect of corrugation depth and use of a face plate. A pronounced weight saving was achieved in the 1977 Firebird Davidson demonstrator bumper system by using a M-190 MartINsite steel reinforcement beam. The formability of MartINsite, its corrosion resistance (need for protection by foam, paint, electro-galvanizing, or ZINCROMETAL treatment), and its basic parameters in various welding processes are discussed. Charts and photographs are included. With minimum yield strengths of 1000 and 1175 MPa, the M-160 and M-190 grades of MartINsite are among the most economical, high strength-to-weight ratio materials currently available.

by B. S. Levy
Inland Steel Co.
Rept. No. SAE-790333; 1979; 14p 5refs
Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 923

SOFT FASCIA CONCEPT FOR 1979 MUSTANG/ CAPRI DESIGN AND MANUFACTURING CONSIDERATIONS

A number of design and manufacturing requirements were considered in the development and application of a large, complex, Reaction Injection Molding (RIM) soft fascia for the 1979 Mustang and Capri front ends. The design and manufacturing process had to be closely coordinated to achieve the fit, functional and appearance objectives of a highly styled one piece soft part. Among the considerations involved were design, material and finish, cost/weight reduction potential, performance, tool material selection and design, selection of molding equipment, and final part finishing. Successful application of the RIM process for large complex 1979 Mustang and Capri front fascias provides another alternative design and styling concept for both front and rear end applications.

by L. W. Moriarty; R. E. England
Ford Motor Co.
Rept. No. SAE-790331; 1979; 10p
Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979
Availability: SAE

HS-025 924

THE STIRLING ENGINE FOR THE AUTOMOTIVE APPLICATION

A description is given of current Stirling engine technology and of the most plausible near term automotive application. Both kinematic and free-piston Stirling engine technology is under development and, although the fundamentals are the same, each configuration demands unique engineering. United Stirling engines are direct shaft output systems, achieving the thermodynamic cycle requirements by phasing the pistons kinematically; free-piston Stirling engines achieve the thermodynamic cycle requirements by phasing the pistons via proper design of the spring-mass system. The engine is essentially a resonant system with frequency largely dependent on the charge pressure of the working fluid. In testing and evaluating engines of different configurations in various applications, a need was found for component research development; extensive laboratory facilities were provided for the design of prototype engine modules. At present, United Stirling of Sweden (USS) is developing Stirling engines with the cylinders in a cluster arrangement, involving dual crankshafts geared to an output power shaft. Data are provided for engines tested in a Ford Taunus station wagon and an 8-ton delivery truck. Although some disadvantages still exist regarding weight and complexity, the latest USS design yields noise emissions as well as toxic constituents in the exhaust products well below the most stringent projected US legislations. The free-piston Stirling engine power generator system may be applied as a propulsion system for a hybrid electric vehicle. Whereas the Stirling engine was selected as the heat conversion element to exploit the high efficiency, low pollution, multi-fuel, and quiet operation of the machine, the free-piston configuration driving a linear alternator was chosen to gain the reliability, long life, and maintenance-free characteristics of a hermetically sealed unit. Photographs, charts and diagrams are provided.

by K. Rosenqvist; T. Lia; B. Goldwater
 United Stirling of Sweden, Malmo, Sweden; Mechanical
 Technology Inc., Latham, N.Y.
 Rept. No. SAE-790329; 1979; 16p 7refs
 Technical Paper Series. Presented at Congress and Exposition,
 Detroit, 26 Feb-2 Mar 1979
 Availability: SAE

HS-025 925

AN AIR/FUEL CONTROL SYSTEM FOR THE STIRLING ENGINE

A repeatable air-fuel control system has been developed for the Stirling engine, providing the wide range of metered fuel flows and adjustable air/fuel ratios required for mapping and optimization of Stirling engine components which placed limitations on conventional fuel metering systems. Besides the requirement for a constant hydrogen temperature, other parameters to be controlled are air/fuel ratio and exhaust gas recirculation (EGR) rate (both to vary as a function of fuel flow). Schematics, charts and diagrams illustrate the air/fuel controls; air flow sensor (Vortair); frequency, and K factor vs. air flow thermal Vortair no. 5; air/fuel control system; the electronic shaping circuitry in the control package; temperature-air/fuel control; the differential drive positioning circuit; air intake and EGR throttle valve positioner; and the mass flow air/fuel ratio vs. mass fuel flow distribution of data points (the initial results of the complete system for several test runs).

by James E. Fenton
 Ford Motor Co.
 EC-77-C-02-4396
 Rept. No. SAE-790328; 1979; 8p
 Technical Paper Series. Presented at Congress and Exposition,
 Detroit, 26 Feb-2 Mar 1979
 Availability: SAE

HS-025 926

THE 1978 TRAFFIC STORY. MORE VEHICLES, MORE MILES, MORE DEATHS

The National Safety Council provides statistics on motor vehicle traffic fatalities in the U.S. in 1978. Increases in miles of travel, number of motor vehicles and drivers were accompanied by a 1% increase in the mileage death rate over 1977's rate. Deaths on the turnpike were up 19% over 1977. Injuries causing disability beyond the day of the accident are estimated at about 2 million for 1978, with less serious injuries probably equalling this number. Factors affecting motor vehicle deaths include increased vehicle travel, more vehicles and drivers, higher average speeds, larger numbers of inexperienced drivers, and more light-weight cars, as well as such offsetting factors as: vehicle safety features, limited access highways, engineering improvements on older highways, driver education, defensive driving courses, commercial driver training, safety belts and shoulder harnesses, and better enforcement. All seven regions of the country showed increases in deaths, the largest percentage increases in New England and the Pacific states and the smallest in the Middle and South Atlantic states. Fatalities in rural areas increased over 1977 by 4%; in urban areas by 7%. Categories are presented of death by type of accident and age of victim; fatalities in states and cities are compared. For the year, totals were: deaths, 51,900; injuries (disability beyond day of accident), 2,000,000; costs, \$34,200,000,000; travel 1,520,000,000 miles; rate (deaths per 100,000,000 miles of travel), 3.41; MV registration, 154,000,000; population, 218,059,000.

by J. L. Recht; Barbara Carraro
 Publ: Traffic Safety v79 n3 p14-6, 22-3 (Mar 1979)
 1979
 Availability: See publication

HS-025 927

CAN SMALL CARS DO THE POLICE JOB?

Since 1973 the California Highway Patrol (CHP) has been experimenting with compact and intermediate cars. Because the downsizing of vehicles to meet Federal and state safety, gas mileage and smog requirements will inhibit vehicle performance, the CHP has studied methods of adapting future cars to the requirements of law enforcement. Intermediate-sized cars were purchased as replacements for retired vehicles; during 1977 the CHP tested mid-sized Chevrolets, Pontiacs and Dodges with 350- to 360-cubic-inch engines, comparing them to the former high-powered 440-cubic-inch engines. They were generally acceptable, although the top speed was less than required in previous years. Similar experiments and evaluations continue, including determination of what size vehicles will be available and how small cars can be outfitted with all the special equipment carried in patrol vehicles, while providing room for transportation of arrested persons. Even if Congress adopted an exemption to the law requiring 27.5 mpg by 1985, which might allow manufacturers to build large, high-powered cars for police use, it would be economically impossible for Detroit to build them. By 1983, new cars purchased by law enforcement agencies will probably have a lower speed capability than a large number of older civilian cars. The CHP believes this will not result in a critical problem because most drivers of those cars will not attempt to flee from traffic officers, and because most of the handicap of slower speed in pursuit is overcome by the professional driving expertise of police and by the use of sirens, red lights, radio and aircraft.

by Lloyd E. Sellers
 Publ: Traffic Safety v79 n3 p18-9, 28 (Mar 1979)
 1979
 Availability: See publication

HS-025 928

ANALYSIS OF LARGE HEAD-NECK MOTIONS

An eleven-element lumped parameter two-dimensional model of the human head-neck system was developed to predict the motion of the head and neck under impact loadings and upper torso accelerations that represent "whiplash" conditions. The model incorporates mechanical analogies for the intervertebral disks, muscles, ligaments and articular facets. These simulations are composed of springs and dashpots with both linear and nonlinear moduli. The forces developed in these substructures are calculated as functions of the deformation of the system, as employed in the equations of motion. The model was tested by comparing the experimental and analytical results for the head motion determined from force inputs and data reported by other researchers from three different experiments. In general, high satisfactory agreement was found to exist between predictions and data, despite parameter matching problems. The forces and stresses extant in the individual subsystems were also examined for one of the test runs. Force histories were plotted for elements which were representative of the maximum force level calculated. A procedure was also developed to approximate the strain in the spinal nerve. Strains greater than the current biological material test ranges were predicted, indicating the need for extended testing of these materials and the acquisition of more accurate element strength parameters. Methods to i

prove and expand the model are discussed, with particular reference to the extension of the model to three dimensions.

by Jan G. Reber; Werner Goldsmith
NIH-5R01-AM18384; N00014-76-C-0686
Publ: Journal of Biomechanics v12 n3 p211-22
1978; 26refs
Availability: See publication

HS-025 930

TOWARD A NEW DIRECTION IN BICYCLE TRANSPORTATION POLICY

The present policy for improving bicycle transportation facilities does not provide adequate Federal and state assistance to local governments. A review of the evolution of the policy discusses the deficiencies of earlier programs, including insufficient delegation of decisionmaking authority to local governments with regard to expenditures of local transportation monies, the imposition of direct model competition at the state level between bicycle facility and highway funding, and interchangeable or ephemeral program durations, making capital budgeting and system development decisions difficult beyond one year. A unified policy and programming strategy for remedying these deficiencies is presented, the framework for which is already contained in Federal transportation regulations under Transportation Improvement Program (TIP)/Transportation System Management (TSM) requirements. A new approach should focus on local discretion and continuous funding; it should also attempt to further the integration of bicycle facility planning and development with those of other modes, and should not force these operations to the outer reaches of the transportation decisionmaking process. It is recommended that the TIP/TSM concept be extended both horizontally, to encompass all areas of urban character in project funding, and vertically, establishing a new funding category for TSM projects by which Congressional appropriation bills would include money to be programmed by the states to develop locally-designated TSM projects, administered by the local planning organization.

by John B. Corgel; Charles F. Floyd
Publ: Traffic Quarterly, v33 n2 p297-309 (Apr 1979)
1979; 15refs
Availability: See publication

HS-025 931

VEHICLE MASS AND DRIVER INJURY

The effect of vehicle mass on the severity of injuries sustained by drivers in head-on collisions is analyzed using data obtained from reports of rural accidents in the U.K. (1969-1972). In two-vehicle crashes, a consequence of Newton's laws is that relative velocity change is in inverse proportion to vehicle mass. Increased velocity change causes increased severity of injury. The data examined show, for instance, that when the larger vehicle is twice the mass of the other, the percentage of fatalities in the lighter vehicle is about six times that in the heavier vehicle. The effect of mass alone on driver injury, considering only those two-vehicle head-on crashes in which the vehicles were of nearly equal mass, was found to be negligible.

by G. Grime; T. P. Hutchinson
Publ: Ergonomics v22 n1 p93-104 (Jan 1979)
1979; 15refs
Sponsored by Transport and Road Res. Lab. (England).
Includes German summary.
Availability: See publication

HS-025 932

INTERSECTION ETIQUETTE

Proper driver behavior at intersections, reflective of both good manners and good sense, is illustrated for various situations. It is pointed out that accident reports compiled for 11 states in 1977 showed that 21.3% of the accidents were the result of right-of-way violations. The question of right-of-way generally is a matter of politeness. The rules are outlined for the following situations: intersection with no stop or yield signs when drivers arrive at the same or different times, a stop sign for one driver, turning at two- and four-way stops, turning at intersection with stoplight with no left-turn arrow, intersection with flashing, malfunctioning, or unlit stoplight, right turn on red, U-turns, blind intersection, and intersection with pedestrian, bike, and animal traffic. The important element of good motoring etiquette is to realize that the other person (motorist, cyclist, or pedestrian) also has a right to be at a particular intersection and that allowing him to go first takes only a small amount of patience and politeness.

Publ: Driver v12 n10 p14-20 (Mar 1979)
1979; 1ref
Availability: See publication

HS-025 933

STUDY OF THE EFFECT OF BUMPER HEIGHT ON THE FRONT ENDS OF TRUCKS DURING COLLISIONS WITH AUTOMOBILES (ETUDE DE L'INFLUENCE DE LA HAUTEUR DES PARE-CHOC AVANT DES VEHICULES UTILITAIRES LORS DE CHOCS CONTRE DES VOITURES PARTICULIERES)

In an effort to develop an anti-underride device for truck front bumpers, a dimensional study of commercial-vehicle front ends (length of front overhang, ground clearance of forward bumper, and angle of front overhang) was made and a test program of car-truck head-on impacts was conducted. Even when a truck's front bumper is optimally located relative to a car's hood (height of bumper between 600 mm and 680 mm, based on European car population), there is no guarantee that underride will be confined to the area forward of the windshield arc, requiring use of a supplementary device. Two underride guards adapted to highway trucks (bumper height of 400 mm) and heavy-duty trucks (bumper height of 800 mm) were designed and tested. Results using these devices show that the severity of a head-on collision with a car is reduced compared to trucks without the guards. The results apply only to average vehicles (height of front end of hood approximately 700 mm, and length of hood more than 1000 mm).

Economic Commission for Europe, Reporting Group on General Safety Measures
Rept. No. TRANS/SC1/WP29/GRSG/R.86; GE.78-28214; 1978; 60p 2refs
Translated from French (original 31p; translation 29p).
Presented at 32nd Session of Economic Commission for Europe, 31st Session of Reporting Group on General Safety Measures.
Availability: Reference copy only

HS-025 934

DRIVING INTO SPRING [AUTOMOBILE MAINTENANCE AND DRIVING TIPS]

The first maintenance item suggested for the car owner during the spring season is to wash the car thoroughly to remove dirt

and salt accumulated during the winter. After cleaning, the car should be inspected for scratches and those found filled in with touch-up paint (not over rusted areas). Hoses, fanbelts, and underhood wiring should be checked for salt damage, and the exhaust system examined for rust spots. The spring check should include windshield wipers and washer solution reservoir, as spring is a season of rain, mud, and fog. A front-end alignment check is advised after a winter of driving over ice and potholes. Tires need to be examined for cuts, cracks, bulges, and tread wear (the tread's main job being to provide traction on wet surfaces). Tips for driving in the rain include the following: double check for hard-to-see vehicles coming up behind; turn on lights if it is hard to see other traffic; be alert; reduce speed in areas of accumulated water (or whenever it is raining) and once clear of water, lightly apply brake pressure to dry the brakes; if stuck in mud, gently rock vehicle back and forth and repeatedly shift from drive to reverse (automatic) or reverse to second (manual) while applying moderate pressure to accelerator; and check road conditions along a normal route and avoid trouble spots if possible. It is also recommended to keep an adequate distance between one's car and tractor-trailers, to avoid rear-end skidding accidents and to avoid splash and spray. The deteriorating condition of many highways and bridges is outlined, indicating need for extra caution.

Publ: Driver v12 n10 p1, 3-5 (Mar 1979)
1979

Availability: See publication

HS-025 935

THE DRINKING-DRIVER PROBLEM--WHAT CAN BE DONE ABOUT IT? REPORT TO THE CONGRESS OF THE UNITED STATES BY THE COMPTROLLER GENERAL

Major activities of the Dept. of Transportation (specifically, the National Hwy. Traffic Safety Administration) to combat the drinking-driving problem are described, as well as various drinking-driver countermeasure programs being conducted by state, local, and foreign governments, and by private organizations. Obstacles are identified which have affected the ability of these organizations to address the problem effectively. Despite the various countermeasure programs, statistics continue to indicate that, overall, one-half of U.S. highway fatalities (about 25,000 persons annually) are alcohol-related. Society's general acceptance of mixing drinking with driving is seen to be the main obstacle to a successful anti-drinking-driving campaign. Before alcohol-related accidents can be significantly reduced, a long-term commitment must be made, probably lasting for generations, with all government levels, educational institutions, and the general public working together to bring about the desired change in attitudes toward drinking and driving. It is imperative that the Secretary of Transportation initiate a leadership role in this effort by providing encouragement, technical assistance, and all possible financial assistance to state and local governments and private organizations to reduce the problem. The most promising approaches appear to be media education, formal education, enforcement, and rehabilitation.

General Accounting Office, Community and Economic Devel.
Div., Washington, D.C. 20548
Rept. No. CED-79-33; 1979; 64p
Availability: General Accounting Office, Distribution Section,
Room 1518, 441 G St., N.W., Washington, D.C. 20548

HS-025 936

VEHICLE DRIVERS AND FATAL ACCIDENTS

An exploratory investigation was made of the psychological consequences of fatal accidents to involved drivers, whether or not the driver was at fault, in an attempt to determine what crisis intervention, if any, is needed for such drivers. A total of 33 drivers participated who were involved in a fatal accident from 6 months to 11 years prior to the interviews. The range of time for drivers to resolve their crises seemed to be from a few hours to years after the accident. The crises created many psychosocial and physical problems for these drivers. The support of family, friends, and significant others was the most important variable for the drivers in crisis resolution. Condemnation hindered them most. It is indicated that drivers characterized in one or more of the following ways may need professional help in crisis resolution: severely injured in accident, convicted, related to or friend of deceased, consumed alcohol immediately prior to accident, have prior emotional problems, have no emotional supports from family or friends, or received public condemnation regarding their fault for accident. The data tentatively suggest that in the resolution of crisis the driver should receive support from significant persons, should discuss his feelings about being involved in the death of another person, should discuss the accident, grieve, drive again, drive more defensively, and should make some form of restitution.

by Merle M. Foeckler; Frances Hutcheson Garrard; Catherine Chinnis Williams; Alice M. Thomas; Teresa J. Jones

Publ: Suicide and Life-Threatening Behavior v8 n3 p174-82
(Fall 1978)

1978; 14refs

Availability: See publication

HS-025 937

EFFECT OF CHANGING AUTOMOBILE MATERIALS ON THE JUNK CAR OF THE FUTURE

Annual projections are presented of the amounts of metallic and nonmetallic materials available for resource recovery from the average junk car from 1974 through 1995. The junk car recycling industry is likely to see major changes in the composition of processed automobiles during the future decades. It is estimated that there will be a 60% reduction in ferrous metals available per vehicle between 1982 and 1995. There is potential for an increase in the content of zinc and alloying elements present in the ferrous scrap. A major change will occur in the composition of nonferrous residue, including a fourfold increase in aluminum content, a 33% decrease in copper and brass, and a reduction in die-cast zinc content to less than one-tenth of current levels. An increase in the plastics and rubber content of the junk car should be more than double the present levels by 1995. Automobile shredders are likely to continue to be the most efficient junk car recyclers, although competition will be intense for the larger number of smaller cars that will have to be processed in order to maintain a constant ferrous-scrap production rate. Similarly, the presence of large aluminum parts in the junk car may encourage car strippers to remove these parts before shredding; if so, the nonferrous-metal processors will have to handle larger quantities of rubber and plastics to recover the decreasing metal quantities they will receive. This change may accelerate development of resource-recovery processes for the plastics and rubber residue of the junk car industry, with pyrolytic processes appearing to be the most promising approach to handle these materials while simultaneously providing a new source of fuels.

by L. R. Mahoney; J. Braslaw; J. J. Harwood
Ford Motor Co., Dearborn, Mich.
Rept. No. SAE-790299; 1979; 10p 8refs
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 938

CHILD RESTRAINTS IN CARS--AN APPROACH TO SAFE FAMILY TRANSPORTATION

Information and recommendations are presented on child safety in automobiles, based on four comprehensive studies conducted by Volvo in Sweden. The first study involved an analysis of 62 car crashes during 1973-1975 in which 65 children under the age of 15 were killed; the types of injuries suffered by different-aged children traveling in different ways were analyzed. The second study dealt with 683 accidents with 822 children under 15 sitting in the front and rear seats, of which 103 children wore adult seat belts; injury frequency was compared for children wearing belts, children without belts, and adults wearing belts; consideration was also given to the risk of neck injury caused by belt usage for passengers less than 160 cm tall. The third study analyzed 556 severe accidents in Volvo 140 and 240 cars during 1974-1975 in which at least one child was involved; the positions of the children in the car and the way in which their injury patterns were influenced by different locations, positions, ages, etc., were investigated, and a comparison made of injuries sustained by adults and children in the same accidents. The last study was an attitude survey of 705 Volvo employees with children under 15 regarding how their children travel in vehicles, problems occurring with different traveling positions, and the use of restraint systems. It is recommended that children 0-9 months of age lie in a pram insert (i.e. portable carriage) placed on a child bench just behind the front-seat back rests and stabilized with cushions. For the 10 mo-to-3-yr age group, a child seat facing rearward is recommended. For 4-6-yr-olds, use of a child seat is recommended for as long as possible. For 7-10-yr-olds, a three-point belt in the rear seat and belt cushion should be used. The 11-14-yr-olds should use the three-point belt.

by Hans Norin; Eva Saretok; Kjell Jonasson; Ake Andersson; Bengt Kjellberg; Sture Samuelsson
Volvo Car Corp., Product Devel. and Engineering
Rept. No. SAE-790320; 1979; 15p 19refs
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 939

TRUCK AND BUS SIZES AND WEIGHTS. 1979 ED.

Legal limits for length, height, width, and weight of trucks and buses are provided according to the individual states. Truck lengths and weights are given for various single units and combinations. The truck weights are computed either in practical gross weights or in maximum gross vehicle weights. Interstate System maximum weight and width limits are given, with state-by-state comments and exceptions. Included is a summary of size and weight legislation considered in the 50 states and the District of Columbia from 1 Sep 1977 to 31 Dec 1978. In general, the western states have the most liberal limits due to interstate commerce routes, which afford long distances of uninterrupted travel, and their low population density. Eastern states, which have large populous metropolitan areas, are generally more restrictive, specifying lower length and weight limits. Limits are also affected by the type of commerce in the state;

higher weights are sometimes allowed for specific commodities such as coal.

Motor Vehicle Manufacturers Assoc. of the United States, Inc.,
300 New Center Bldg., Detroit, Mich. 48202
1979; 36p
Availability: Corporate author

HS-025 940

ADVANCED RESTRAINT SYSTEM CONCEPTS

The seat belt pretensioner designed to eliminate seat belt slack in lap/shoulder belt systems with emergency locking retractors is described, as well as the current Mercedes-Benz passive restraint system which consists of air bags deployed by means of solid-propellant gas generators, knee bolsters, and an electronic crash sensor with dual-level triggering function. Two different designs are considered which compensate for the performance limitations of the lap/shoulder belt (i.e. does not prevent head impact with dashboard or steering wheel in severe accidents) and the air bag/knee bolster system (does not protect in lateral impacts or rollovers and only to a limited extent in multiple-impact accidents). For a modern lap/shoulder belt system, the supplementary elements can be an air bag in the steering wheel and a pretensioner for the passenger belt. For an air bag/knee bolster system for frontal impact protection, supplementary belts with high-elongation webbing or force limiters can be used. This webbing is not in compliance with current U.S. and European seat belt regulations, which therefore should be amended.

by W. Reidelbach; H. Scholz
Daimler-Benz A.G., Stuttgart, Germany
Rept. No. SAE-790321; 1979; 14p
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 941

HIGHWAY SAFETY REVIEW. REPORT OF THE SAFETY REVIEW TASK FORCE TO THE FEDERAL HIGHWAY ADMINISTRATOR

A national safety review of recently-completed Federal-aid highway projects was undertaken to determine if such projects were following current safety principles and concepts, and safety upgrading projects on older Federal-aid highways were reviewed to determine their timeliness and impact on safety. Reviews were performed in all 50 states, Jan-Apr 1978, except for Alaska (Jun 1978). Information has been assembled in the following sections dealing with specific areas of concern: accident data, safety performance reviews, barrier systems, signing, transitions, pedestrians, gore areas, bridges, striping, trees, rock cuts, pavement surfaces, roadside delineators, highway lighting, impact attenuators, maintenance, and training. Photographs at the end of the sections illustrate the general overall appearance of many of the projects reviewed. General findings and recommendations are provided. It was found that Yellow Book (Highway Design and Operational Practices Related to Safety) safety concepts have been incorporated into new projects; that wide variations exist among states with respect to safety upgrading of the Interstate system; that states generally place low priority on safety upgrading of non-Interstate systems; that there is limited use of accident data to evaluate performance and safety features; that some roadside signing and hardware are not in conformance with standards; that general policies need to be clarified in a number of areas; and that division offices need to strengthen their influence over state safety policies. (Guidelines for Dec 1977 Federal Hwy. Administration safety review are appended.)

HS-025 942

Federal Hwy. Administration, and National Transportation Safety Board, Safety Review Task Force
1978; 132p
Availability: GPO

HS-025 942

SAE [SOCIETY OF AUTOMOTIVE ENGINEERS] MATERIALS '79

A preview is presented of the 1979 Society of Automotive Engineers Congress and Exposition to be held in Detroit from 26 Feb through 2 Mar, featuring two all-day sessions on graphite-fiber-reinforced plastics (GrFRP) and other high-strength composites as part of a rich technical program covering lightweight materials and other subjects. Included are 22 half-day sessions on materials engineering which will cover developments in steel, powder metals, "friendly" plastic moldings, composite forming and jointing techniques, coatings for plastic and rubber materials, material-finishing problems, aluminum radiators, and prospects for lightweight wheels. Ford will be unveiling its graphite-composite car, a special 1979 full-size LTD that contains approximately 130 GrFRP parts, weighs about 1200 lb less than its production counterpart, and equals compacts and some subcompacts in fuel economy. In a surprise development, Chrysler will be displaying a converted LeBaron coupe that combines graphite-composite components with other existing lightweight materials. An aluminum "theme" car, equipped with new 1979 and carryover applications for the light metal, will highlight the Aluminum Assoc.'s exhibit.

by Al Wrigley
Publ: Ward's Auto World v15 n3 p61-3, 65, 67 (Mar 1979)
1979
Availability: See publication

HS-025 943

MATERIALS [AUTOMOBILE INDUSTRY]

Any estimate about the extent of the use of various materials in the auto industry during the early 1980's is based on assumptions about technology (e.g. the diesel engine as a viable powerplant, particulate standards, corrosion-free cars). As the auto industry meets fuel economy requirements by reducing vehicle weight (via lightweight materials such as reinforced plastics), corrosion resistance could well become an important issue. Providing better corrosion protection for metals means adding to costs, which improves the competitive position of plastics and clad metals. Detroit is already using clad metals moderately (e.g. stainless clad aluminum for trim). Clad metals have advantages for automotive applications, particularly for brightwork. Stainless clad aluminum offers both corrosion-resistance and weight savings. A potential application is bumper faceplates on luxury cars. Future materials use is reflected mainly in the small-car market. One of the next major automotive parts expected to convert from sheet metal to plastic is the front fender, to be constructed of reinforced reaction injection molded (RRIM) urethane elastomer, the first RRIM production part. The auto industry is considering fender extensions, hoods, and decklids as potential applications for RRIM. By 1985, electric vehicles will be more popular and will rely on plastics to produce lightweight chassis to counteract battery weight. Other materials and processes being developed for automotive applications include reinforced super-tough nylons, new polyester resins, elastic reservoir molding, glass-filled RIM materials, and various hybrid products. Spare tire wheels will soon convert to plastics and other wheels by the mid-1980's, radiator supports should appear in 1980, leaf springs in 1981, and plastic fenders,

bumper systems, doors, decklids and hoods probably in 1981. These items will be installed on some key production cars, not across the U.S. fleet.

by Robert A. Wilson
Publ: Automotive Industries v159 n3 p39-46 (Mar 1979)
1979; 2refs
At head of title: Designers' Handbook.
Availability: See publication

HS-025 944

ELECTRONICS [AUTOMOBILE INDUSTRY]

Ford Motor Co., Chrysler Corp., and General Motors Corp. have begun to introduce electronic engine control systems in response to emission control and fuel economy standards. The most advanced and complete engine control to date is Ford's Electronic Engine Control II (EEC II) which uses seven sensors to determine crankshaft position, throttle position, coolant temperature, exhaust gas, manifold absolute pressure, and exhaust gas recirculation. EEC II monitors the engine's operating modes and adjusts them for optimum performance in economy, emissions, and driveability. Chrysler's Electronic Feedback Carburetor Control System (EFCCS) regulates the air/fuel mixture based on engine temperature and acceleration conditions. The EFCCS incorporates electronic spark control which replaces the lean burn system, reflecting a change from running lean to running for fuel economy. GM's electronic control system, a closed-loop system called the Computer Controlled Catalytic Converter (C-4) consists of an electronic control module, a coolant temperature sensor, an oxygen sensor, a solenoid in the carburetor, a catalytic converter, and a diagnostic light on the dashboard. GM's Buick Div. has developed an electronic spark control system for turbocharged engines, the Turbo Control Center, which monitors detonation level in the engine, retards spark to control detonation during boost, and advances spark under normal operating conditions. In addition to electronic engine control, other areas of electronics application include fuel injection, trip computers, warning indicators, speed control, climate control, ignition, voltage regulators, and headlight dimmers.

by John McElroy
Publ: Automotive Industries v159 n3 p55-8 (Mar 1979)
1979
At head of title: Designer's Handbook.
Availability: See publication

HS-025 945

TESTING AND AUTOMATION [AUTOMOBILE INDUSTRY]

In addition to the implementation of more advanced testing procedures by the U.S. auto industry in an effort to improve product quality, quality is being stressed in the manufacturing process. One aspect of manufacturing improvement is the use of robots to take over many dull and dangerous jobs and to perform them more quickly and efficiently. While robots are already tackling sophisticated manufacturing tasks worldwide (e.g. robotic system being used at SOFIM's diesel engine plant in Foggia, Italy to shift completed engines off the production lines into engine test rooms), General Motors (GM) has developed a robot with vision. GM says that it is technically feasible to equip robots with a number of other sensory capabilities, but it believes that robots with visual guidance have the greatest potential for automatic applications. Automotive parts pass through a light beam projected on the conveyor belt. A solid

state, electronic digital camera connected to a computer is aimed at the beam of light. When a part blocks the light, it enables the computer to form a silhouette. The robot "recognizes" the part's silhouette through its memory bank and "remembers" where to put it. Another GM product is its Programmable Universal Machine for Assembly which is essentially a robot without vision, programmed by a computer to assemble small components. Also illustrated are Ford's Micro-computer-Based Mobile Data Acquisition System for collecting durability testing data, and Ford's 10-channel servo-hydraulic road simulator for duplicating road conditions to evaluate structural integrity.

by John McElroy
 Publ: Automotive Industries v159 n3 p59-62 (Mar 1979)
 1979
 At head of title: Designer's Handbook.
 Availability: See publication

HS-025 946

HIGHER STRESS CALLS FOR BETTER BEARINGS [AUTOMOTIVE ENGINES]

Higher-performance cars require heavier-duty engine bearings such as lead-bronze bearings, and Vandervell Products Ltd. (England) is one of the few companies in the world capable of continuously casting the bronze onto the steel backing strip. Lead bronze is the thin-wall bearing material with the highest strength, withstanding pressures up to about 6500 psi (44,817 kPa). Vandervell uses a process in which the edges of the steel backing strip are turned up to form a channel into which the molten bronze is poured. A comparatively soft coating is used to provide the embedability (i.e. ability to absorb small dirt and metal particles without journal damage) not inherent in the hard lead-bronze shell. The coating used by Vandervell is unique in that it uses a rare element (indium) and is electrodeposited. Indium has the disadvantage of extremely high cost (about \$.25 million/ton), but lead-indium is stronger than lead-tin-copper, has superior wear resistance to lead-tin, and has excellent corrosion resistance.

by Peter J. Mullins
 Publ: Automotive Industries v159 n3 p71-2 (Mar 1979)
 1979; 1ref
 Availability: See publication

HS-025 947

CONGRESSMAN TACKLES EXTREME AUTO LAWS

Congressman David Stockman, A Republican from Michigan's Fourth District, is highly critical of Dept. of Transportation (DOT) automotive standards and Environmental Protection Agency (EPA) emission control standards, stating that they adversely affect the auto industry and the motoring public. It is his opinion that the fuel economy standards need to be revised, if not entirely eliminated, that there is growing skepticism in Congress about their cost/effectiveness, and that they have the clear potential to drastically limit the consumer's choice of products. Rep. Stockman believes that the EPA standard for ozone (major indirect pollutant created by cars) is too stringent at .12 ppm, and that a level in the range of .2 ppm would be more adequate. Another source of contention is the regulation of hydrocarbons (HC) in auto emissions; by the time the 1981 standard (.4 g) is reached, the Congressman states that a large fraction of the HC will be methane which is nonreactive and has no effect on ozone levels. Rep. Stockman would also like to repeal DOT's authority to promulgate mandatory passive re-

straints in the form of air bags. The Congressman believes that the underlying motivation of the regulatory authorities is to undermine the role of the automobile in American society.

by Joseph M. Callahan
 Publ: Automotive Industries v159 n3 p77-9 (Mar 1979)
 1979; 1ref
 Availability: See publication

HS-025 948

INJECTION OF HOPE FOR BIG CARS [ELECTRONIC FUEL INJECTION]

Bendix's Sequential Multi-Point Electronic Fuel Injection (SMEFI) system can hold nitrogen oxides (NOx) emissions at .31 gpm, hydrocarbons (HC) at .24 gpm, and carbon monoxide (CO) at 2.7 gpm, well under the 1981 statutory limits of .4 NOx, .41 HC, and 3.4 CO. The system offers fuel economy of 15.2 mpg/city and 20.8 mpg/highway. Although the SMEFI system appears very promising on paper, Bendix is careful to point out that 50,000-mi endurance testing on a fleet of cars is necessary to validate these figures. With the SMEFI system, each cylinder has its own injector (hence the multi-point), and the injectors operate in the same sequence as the firing order of the engine (thus sequential). The system is composed of several sensors which monitor the engine and its environment, injectors which deliver the fuel, and an Electronic Control Unit which monitors the sensor's signals and turns them into operating orders for the injectors. The system also requires two fuel pumps to maintain 39 psi pressure in the fuel line and a better filtering system to prevent injector plugging. The sequential EFI system has six more driver circuits than production EFI. In addition to emissions and fuel economy advantages, sequential EFI eliminates the air pump and the clean-up catalytic converter, is virtually tamper-proof, offers an improvement in evaporative emissions, and will readily accept gasohol with a minor change in rubber parts and recalibration. By 1981, smaller engines will probably use Throttle Body Fuel Injection (where only one or two injectors mounted in a carburetor-like throttle body fire continuously), and any engine under 2.0 L will have an electronic carburetor. Bendix predicts that half of the new passenger cars in the mid-1980's will have sequential EFI.

by John McElroy
 Publ: Automotive Industries v159 n3 p81-3 (Mar 1979)
 1979
 Availability: See publication

HS-025 949

'79 ROOMINESS INDEX ABOUNDS IN SURPRISES [INTERIOR SPACE IN CARS]

An Automotive Industries Roominess Index is presented for each of the 1979 model year cars, with 1978 indexes provided for comparison. The roominess index is calculated by totalling the seven major interior dimensions of the lowest priced sedans in each line (4-door, or 2-door if no 4-door is offered). Individual dimensions (in and cm) are provided for the front seat height, front and rear head room, front and rear leg room, and front and rear shoulder room. While the general trend toward downsizing continues, 11 of the 58 new cars have larger interiors for 1979 than 1978. A number of new cars which have essentially the same bodies in 1979 as in 1978 have larger Roominess Indexes. Twenty-seven of the 58 cars maintained their exact 1978 interior dimensions; 14 have less room; six were introduced between the fall of 1977 and the fall of 1978. The 1979 Lincoln has the largest interior of any car in the U.S. and probably in

the world, but will probably be downsized next year. The largest cars in each of the 1979 categories are Chevette for a minicar (it being the only one), Pacer among the subcompacts, Volare and Aspen among the compacts, Malibu among the intermediates, Ford among the standards, Toronado among the personal luxury models, and Lincoln among the luxury cars.

by Joseph M. Callahan

Publ: Automotive Industries v159 n3 p93-5 (Mar 1979)
1979

Availability: See publication

HS-025 950

QUALITY GETS TOP PRIORITY IN \$80-BILLION REVAMPING, MANUFACTURING AND TESTING SPECIAL REPORT [AUTOMOBILE INDUSTRY]

To manufacture smaller, lighter, more fuel-efficient automobiles to meet the corporate average fuel economy standard of 27.5 mpg by 1985, the auto industry will spend \$80 billion for its new products, of which about half will go into engineering, research and development, preproduction, and project expenses; the remainder will be spent on new tooling, facilities, and production systems. To build new, more-efficient products, manufacturing facilities must be fitted with state-of-the-art equipment. Manufacturing quality is receiving top priority. The auto industry is asking its suppliers to build and deliver machinery that can perform at much closer tolerances, have higher feed rates and higher rates of production, and can be programmed and numerically controlled. General trends for machine tools will call for more computer control for added flexibility in the manufacturing process. In this effort to improve product quality, there is increasing interaction among design, engineering, manufacturing, and testing areas. GM, for example, says that it is entirely possible that computers will control about 90% of all new machines in its manufacturing and assembly operations within a decade. The first vision-equipped robot will be installed at GM's Delco Products Div. plant in Rochester, N.Y. this year. Parallel with advanced manufacturing methods are advanced testing procedures and equipment, such as computer diagnostic testing of engines and electrical systems and accelerated corrosion testing. Volkswagen of America Inc. procedures which possibly may be adopted by other automakers in the future include emission testing at the assembly plant, and in-line sequence of assembly. By 1985, when almost all auto plants have been updated or completely refitted, it is possible that U.S. automakers could have higher efficiency, productivity, and quality than foreign manufacturers.

by Michael A. Nickle

Publ: Ward's Auto World v15 n3 p69-70, 72 (Mar 1979)
1979

Availability: See publication

HS-025 951

VOLKSWAGEN PASSIVE OCCUPANT PROTECTION SYSTEM PROGRESS REPORT--1979

Results of the most recent tests made in accordance with Federal Motor Vehicle Safety Standard 208, and field experience of the Volkswagen Passive Restraint System (VWRA), installed in over 110,000 VW Rabbits since 1975, are described and compared with the three-point active belt system. The passive VWRA system consists of a torso belt with dual-sensitive automatic locking retractor, knee bolster, seat, and seat belt anchor-age connected to the seat frame. Results of 0 degree frontal barrier crash tests show the Head Injury Criterion (HIC) value

to be significantly higher with the three-point belt system with the VWRA. A higher HIC was obtained in these tests when a lap belt was added to the VWRA system, due to greater tendency for the head to rotate downward. Results of the three-point and VWRA systems were similar during impacts against a 30 degree barrier. There was no detectable difference in lateral collisions between the three-point and VWRA systems. Updated reports of accidents involving RSVs equipped with the VWRA provides information on impact locations and frequencies, passenger contact areas, estimates of injury (Abbreviated Injury Scale) as a function of repair cost, and as a function of equivalent barrier impact speed for frontal impacts. These statistics on U.S. accidents demonstrate the effectiveness of the VWRA in actual use.

by Ulrich W. Seiffert

Volkswagenwerk A.G., Res. and Devel., Wolfsburg, West Germany

Rept. No. SAE-790326; 1979; 8p 2refs

Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979. See also SAE-770935, SAE-780935, and SAE-730935.

Availability: SAE

HS-025 952

OCCUPANT PROTECTION IN A RESEARCH SAFETY VEHICLE

The protection afforded to the occupants of the Research Safety Vehicle (RSV) being developed for the National Hwy. Traffic Safety Administration by Calspan Corp. and Chrysler Corp. is identified by giving examples of the results of staged collisions. A brief review of the four-phase RSV program, vehicle development, and ultimate goals is provided as a frame of reference for the discussion of crashworthiness. The aim of the program is to develop a lightweight advanced safety vehicle design suitable for family transportation in the 1985 time frame. The vehicle design is intended to be compatible with current mass production techniques as well as with fuel economy standards for the 1980's, to be recyclable and producible with a minimum expenditure of energy, and to be capable of being produced at a competitive price. Data and photographs obtained from tests conducted during Phase 3 are provided and discussed. Results of these front, side, and rear-end collisions using instrumented dummies indicate occupant survivability in the 40 to 50 mph range.

by G. J. Fabian

Calspan Corp., Advanced Technology Center, Buffalo, N.Y.

Rept. No. SAE-790325; 1979; 32p 12refs

Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.

Availability: SAE

HS-025 953

HIGH AND LOW RATE FORCE-DEFORMATION CHARACTERISTICS OF MOTORCYCLE HELMETS

The load-displacement characteristics of 15 motorcycle helmets were determined at displacement rates from quasi-static to 1000 in./min. Seven of the helmets had polycarbonate outer shells, the remaining shells being of fiberglass construction. The stiffness of the helmets with polycarbonate shells was found to be uniform, both with loading rate and magnitude of load, that of fiberglass shell helmets. Use of these data to predict helmeted head force and acceleration after impact with a surface is illustrated using a mathematical model. Results indicate that a major function of the helmet is to act

energy-storage element interposed between the head and the impacted surface. Contrary to many statements in the literature, the role of the helmet as an energy-dissipation device is probably not of major significance.

by Herbert B. Kingsbury; Wayne C. Herrick; Dinesh Mohan
University of Delaware, Dept. of Mechanical and Aerospace
Engineering, Newark, Del.; Insurance Inst. for Hwy. Safety,
Res. Dept., Washington, D.C.
Rept. No. SAE-790324; 1979; 15p 11refs
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 954

EFFECTIVENESS OF CURRENT AND FUTURE RESTRAINT SYSTEMS IN FATAL AND SERIOUS INJURY AUTOMOBILE CRASHES. DATA FROM ON-SCENE FIELD ACCIDENT INVESTIGATIONS

Data from the Univ. of Michigan's Hwy. Safety Res. Inst. files on 101 front-seat automobile occupant fatalities were reviewed along with data on 70 front-seat automobile occupants who sustained severe injuries (Abbreviated Injury Scale 3, 4, or 5) but who did not die. The effectiveness of the lap belt alone, lap-shoulder belt, air bag alone, air bag with lap belt, and the passive shoulder belt was investigated. Estimates reveal that none of the restraints would have prevented 42 to 51 of the fatalities. The air bag with the lap belt, and the lap-shoulder belt system, have the highest potential effectiveness for reducing fatalities (34% for the former, 32% for the latter). The air bag with lap belt has an effectiveness of 68% in reducing the more serious injuries with the lap-shoulder belt nearly as effective (64%). The National Hwy. Traffic Safety Administration's fatality reduction estimates are excessively high and overly optimistic compared to estimates in the present study, but are noticeably lower for serious injury reduction. Comparisons with other restraint effectiveness studies are also noted.

by Donald F. Huelke; Harold W. Sherman; Michael J. Murphy;
Richard J. Kaplan; Jerry D. Flora
University of Michigan
Rept. No. SAE-790323; 1979; 22p 15refs
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 955

FACTORS INFLUENCING KNEE RESTRAINT [AUTOMOBILE OCCUPANT PROTECTION]

A planar mathematical model of lower torso kinematics is described which was developed to provide means of studying factors which can influence the function of lower torso restraint via a padded lower instrument panel or knee bolster. Factors judged to play the most significant role include the following: initial fore-and-aft position of the seated occupant relative to the knee restraint, location of the knee-to-bolster contact, angular orientation of the bolster face, primary axis of the bolster resisting force, variations in vehicle crash parameters (e.g. toepan rotation and displacement and seat deflection), and deformation characteristics of the bolster. The model of a seated occupant includes radiographic and empirical data on the anatomy of the links and joints in the lower extremity. Emphasis is placed on determining a range of reference location, orientation, and primary axis of the knee bolster so that an effective restraint may be provided for 5th percentile female, 50th percentile male, and 95th percentile male occupants.

by Clyde C. Culver; David C. Viano
General Motors Res. Labs., Biomedical Science Dept.
Rept. No. SAE-790322; 1979; 19p 11refs
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 956

ROAD ACCIDENTS AND THE UNFIT DRIVER

Studies are cited concerning the effects of illness, aging, and fatigue on the ability to drive and on traffic accidents. Acute illness is a cause of 1 to 2 per 1000 accidents in most detailed studies. Chronic conditions were found in one survey to contribute to perhaps 5 per 1000 accidents, but there is evidence that chronically-ill drivers more than compensate for disabilities by taking extra care and that they have a better accident record than healthy drivers. Acute illness is difficult to assess in accident studies because it may be masked by serious injury. The general practitioner has a particular responsibility to urge patients to declare disabilities, and the driver has a statutory duty (in the U.K.) to notify the driver licensing authority of any relevant disabilities. A physician must advise his patients about disabilities that preclude driving. A person should not drive if he is feeling ill. Visual defects do not appear to be an important cause of road accidents, but a recent survey showed that a large proportion of middle-aged people were unaware of their impaired long-range vision. Results of many studies have suggested some increase in accidents with age, but there tend to be uncertainties in interpretation. Since elderly drivers tend to perform complex tasks more slowly, depending on total perception and on judgment, irrelevant information may confuse this group. Nevertheless, the elderly driver has the two great assets of caution and experience. To reduce the risks of driving for the elderly, the older driver should consult his doctor about fitness to drive, should take particular care with medications, and should avoid difficult traffic conditions, long hours of driving, and night driving, if possible. Specific limitations and common errors of the elderly driver should be publicized. Doctors must be responsible for warning their elderly patients with disabilities against driving, as the circumstances warrant. A periodic testing of elderly drivers is suggested. A person should not drive if fatigued; drivers should avoid as far as possible driving during normal sleeping hours and for prolonged periods without regular rest stops.

Publ: British Medical Journal v2 n6150 p1471-3 (25 Nov 1978)
1978; 20refs
At head of title: A Modern Epidemic.
Availability: See publication

HS-025 957

ASSESSMENT OF THE EFFECTS OF SHORT TERM DRIVE TRAIN OPTIONS ON THE AUTOMOBILE AND RELATED INDUSTRIES. VOL. 1: MAJOR STUDY FINDINGS. FINAL REPORT

A synopsis is given of findings of a study to assess the potential impact on the automobile and related industries of the production and implementation of short-term (1976 through early 1980's) drivetrain and fuel options; the significant features and effects of each of the devices examined are highlighted. A comparison and evaluation of the spectrum of options are provided based on factors considered to be of major significance in determining the likelihood of their implementation by industry in the short term, as well as an evaluation of a number of Federal policy alternatives. Drivetrain options considered comprise

modifications to the conventional spark ignition engine, the use of alternative engine configurations, and modifications to the transmissions, the differential, and wheels. Fuel options considered include the control of additives and impurities in gasoline, the increased production of diesel fuel, and lubricant modifications. The selected options are characterized in terms of fuel economy improvement potential, exhaust emission effects, safety and noise effects, vehicle performance and driveability effects, development and implementation status, capital investment required for mass production, initial acquisition cost, and industry attitudes and orientation.

Aerospace Corp., Mobile Systems Group, El Segundo, Calif. 90245

NSF-C1038; OEP-7521908

Rept. No. PB-264 421; NSF/PRA-7521908/1/7; ATR-77(7541)-1-Vol-1; 1976; 97p 29refs

Vol. 2, Characterization of Options, is HS-025 958.

Availability: NTIS

HS-025 958

ASSESSMENT OF THE EFFECTS OF SHORT TERM DRIVE TRAIN OPTIONS ON THE AUTOMOBILE AND RELATED INDUSTRIES. VOL. 2: CHARACTERIZATION OF OPTIONS. FINAL REPORT

A detailed characterization and analysis are provided of the significant features of selected short-term (1976 through early 1980's) drivetrain options and fuel effects. Modifications to the conventional spark ignition engine include the following: electronic spark timing control, advanced interactive computer-controlled timing, redesigned spark plug, variable venturi carburetor, sonic flow carburetor, fuel injection, supercharging, and advanced catalyst system. Alternative engine configurations are stratified-charge, rotary, and diesel. Transmission options include five-speed manual with overdrive, four-speed automatic, four-speed automatic with lockup, and continuously-variable transmission. Other drivetrain options comprise new tire composition, larger wheel-rim diameters, reduction in tread thickness, high-pressure tire, and front-wheel drive. Fuel and lubricant modifications consist of unleaded gasoline, lead phasedown, sulfur reduction, antiknock additives, increased production of diesel fuel, and synthetic lubricants. Drivetrain options are described under the following subject items: general description, performance and operating effects (fuel economy, emissions, safety, noise, vehicle performance and driveability), impact on vehicle size and weight, state of development, manufacturability, implementation, economic factors, user acceptance issues, industry attitude and orientation, and other factors. Fuel effects are discussed in terms of the applicable topical areas. A series of tabular matrices is presented which summarize the foregoing characteristics of each short-term option. A list of companies and agencies contacted in the course of the study is appended.

Aerospace Corp., Mobile Systems Group, El Segundo, Calif. 90245

NSF-C1038; OEP-7521908

Rept. No. PB-264 426; NSF/PRA-7521908/2/7; ATR-77(7541)-1-Vol-2; 1976; 479p refs

Vol. 1, Major Study Findings, is HS-025 957.

Availability: NTIS

HS-025 959

THE EFFECTS OF CARBON MONOXIDE ON DUAL-TASK PERFORMANCE

Thirty adult nonsmokers were exposed for four hours to one of three concentrations of carbon monoxide (CO), 5 ppm, 35 ppm, and 70 ppm, to produce blood levels of either 1%, 3%, or 5% carboxyhemoglobin (COHb) after the third hour of exposure. Performance in the double blind study was assessed by a tracking task paired with a peripheral monitoring task, each possessing two levels of difficulty. Results indicated that visual-manual tracking was impaired significantly (by about 30%) during the fourth hour of exposure to 70 ppm of CO, when 5% COHb was reached, as compared to performance at 5 ppm and 35 ppm. The impairment occurred only during the high-frequency tracking condition. Response times of subjects to the peripheral light-intensity changes also increased during the third and fourth hours. Findings suggest that an assessment of the effects of low-level CO on human performance should include an analysis of the demand characteristics of the tasks as well as data on concentration and exposure duration.

by Vernon R. Putz

Publ: Human Factors v21 n1 p13-24 (Feb 1979)

1979; 27refs

Availability: See publication

HS-025 960

THE EFFECTS OF HEADLIGHT GLARE ON VEHICLE DETECTION AT DUSK AND DAWN

Ten experienced drivers performed a series of closed course tests to determine whether a target vehicle, located between other oncoming vehicles in a single-lane convoy, could be detected under various levels of ambient illumination with its low-beam headlights on and off, and with different headlight configurations on the surrounding vehicles. Levels of ambient illumination varied from approximately 0.2 lx to 2100 lx during the experiment. Results indicate that low-beam headlights on surrounding vehicles masked the unlit target vehicle. The degree of masking depended on the level of veiling luminance emitted by the surrounding vehicles and on the level of ambient illumination. It was also found that the target vehicle was more visible under all experimental conditions when its headlights were on than when they were off. Target luminance also must be considered in terms of weather conditions and age of driver. The data indicate clearly that present lights-on laws which require headlights only during the period one-half hour after sunset to one-half hour before sunrise do not consider the reduction in visibility caused by the veiling effects of automobile headlights. Results suggest that, quite apart from the question of any future legislation mandating running lights on new cars, consideration should be given to extending the lights-on period to include from one-half hour before sunset to one-half hour after sunrise.

by Dennis A. Attwood

Publ: Human Factors v21 n1 p35-45 (Feb 1979)

1979; 11refs

Availability: See publication

HS-025 961

A NONLINEAR MODEL DESCRIBING DRIVER BEHAVIOR ON STRAIGHT ROADS

Experiments on a driving simulator were used to develop a closed-loop human operator model for straight-road driving in

the absence of an externally-applied disturbance such as side wind gusts or road roughness. It is shown that a significant portion of the driver's control characteristics can be represented by a stationary, nonlinear system with a single visual input. The driver's visual input is considered to be the angle subtended between the heading axis and a line connecting a point on the lane center at a preview distance with his eyes. An optimization procedure is used to evaluate the model parameters, and it is found that the driver's action can best be represented by a pure time delay cascaded with a classical hysteresis nonlinearity. The self-excited limit cycle frequency and amplitudes of this model system are shown to agree closely with respective quantitative aspects of the experimental data, confirming the validity of the model.

by John Baxter; John Y. Harrison
 Publ: Human Factors v21 n1 p87-97 (Feb 1979)
 1979; 24refs
 Sponsored by Commonwealth Scientific and Industrial Res. Organization.
 Availability: See publication

HS-025 962

AN ASSESSMENT OF VISIBILITY AT THE ENTRANCE OF A LONG VEHICULAR TUNNEL

A field study is described which employs a multifaceted approach to assess the nature and impact of the visibility problems encountered when entering long vehicular tunnels. The study was conducted at the northern entrance to the Hampton Roads Bridge-Tunnel, which lies on Interstate 64 between Hampton and Norfolk, Va., where a pronounced slowdown of south-bound traffic had been observed. An initial photometric study showed illuminance and luminance ratios at the entrance far in excess of published recommendations. These give rise to the black hole effect when approaching the tunnel and to a temporary decrease in visibility after entering, due to transient adaptation. Objects in the dark area created by the tunnel entrance are more likely to be hidden by veiling reflections on the windshield. Performance of a visual task by drivers demonstrated that the windshield reflections rather dramatically reduced visibility into the tunnel. A survey of tunnel users revealed that a substantial number of motorists had at some time experienced difficulty seeing cars immediately ahead of them, primarily around the tunnel entrance during the peak daylight hours. Speed data indicate that motorists slowed down when entering the tunnel, the result of a visibility problem or open-approach geometry. Braking data indicate the majority of motorists entered the tunnel with their feet on the brakes. Traffic-flow data indicate a definite slowdown at the north portal. The fact that the majority of drivers of the lone and lead vehicles applying their brakes did so at distances greater than 44 m suggests that windshield reflections and transient adaptation were not the cause of the initial slowdown. According to the Highway Capacity Manual, the apparent constriction of the roadway produced by the proximity of the walls of the open approach, the curved descent into the tunnel, the closeness of the walls of the tunnel interior, and the presence of oncoming traffic might all be expected to lead to a reduction in speed. Recommendations include extending the reflective tiling of the interior to the tunnel mouth, and applying edge striping to the roadway, beginning at the top of the open approach and continuing throughout the tunnel.

by Edward J. Rinalducci; Douglas A. Hardwick; Arthur N. Beare
 Publ: Human Factors v21 n1 p107-17 (Feb 1979)
 1979; 19refs
 Sponsored by Virginia Dept. of Transportation Safety.
 Availability: See publication

HS-025 963

ROAD ACCIDENTS--SEAT BELTS AND THE SAFE CAR

In support for the passage of a mandatory seat belt use law in the U.K., evidence is cited to allay public doubts about seat belt use. It is pointed out that being trapped by a belt in cases of fire or submersion is a rare occurrence, and that people who are thrown clear of a car are not likely to land in a safe spot. A recent British survey revealed that over one-fourth of ejected occupants were killed, representing nearly half of all deaths; these findings are consistent with many others. Injuries are caused occasionally by the seat belt itself, but usually the accident victim would have been killed or more seriously injured without a belt. Both lap and diagonal belts, when used separately, are more likely to cause injury than the commonly-used three-point type. With the three-point system, injury usually results from a lap strap lying over the abdomen instead of the hips. Otherwise, direct seat-belt loading produces minor injuries. The conclusion from surveys is that seat belts significantly reduce all but minor injuries. Outstanding problems concerning seat belt usage include the need for seat belts to be easily adjustable to the correct position and to different sizes and shapes of wearers, the mandatory fitting of rear-seat belts in new cars, and special restraint systems for infants and young children. The objection to seat-belt legislation because of difficulty in providing for medical exemptions is dismissed. Some experts consider that with sufficiently adjustable belts, almost all exemptions could be eliminated. Enforcement is not seen as a problem, as some countries have gradually brought the wearing rate to 80% to 90% with moderate police activity. In certain countries where rates have fallen off, renewed campaigns and a favorable climate of opinion seem to be important. Completely automatic seat belts, in comparison with air bags, are suggested as the passive restraint of choice and a better solution than current active systems. The car must be viewed as a total safety package, since safety and design features interact. The uncertainty about seat belt legislation presents a problem to auto-makers as the safety criteria differ for belted and nonbelted occupants.

Publ: British Medical Journal v2 n6153 p1695-8 (16 Dec 1978)
 1978; 26refs
 At head of title: A Modern Epidemic.
 Availability: See publication

HS-025 964

1977 ACCIDENTS OF MOTOR CARRIERS OF PROPERTY

Statistics on 1977 motor carrier accidents in the U.S. are tabulated, graphed, and charted. The data were based on accident reports submitted to the Bureau of Motor Carrier Safety by carriers of property subject to the Federal Motor Carrier Safety Regulations. Reportable accidents are those involving a motor vehicle engaged in the interstate, foreign, or intrastate operations of a motor carrier subject to the Dept. of Transportation Act, resulting in the death of a human being, or in bodily injury requiring medical treatment away from the scene of the accident, or in total damage to all property aggregating \$2000 or more. In 1977, of the 29,936 accidents reported, 2,293 were fatal accidents which resulted in 2983 deaths, 2631 injured persons, and over \$39 million in property damage. Of those killed, 485 were truck drivers, and another 184 were other truck occupants, while 2314 were pedestrians or occupants of other type vehicles. There were 18,169 nonfatal injury accidents which resulted in 29,067 injured persons and over \$1.32 billion in damages. The 9474 property-damage-only accidents caused an

other \$72 million in damages. Collision accidents which occurred on over-the-road trips accounted for 56% of the total number of accidents, 75% of the fatalities, 62% of the injuries, and 55% of the property damage. Noncollision accidents which occurred on over-the-road trips accounted for 23% of accidents, 11% of fatalities, 16% of injuries, and 34% of property damage. Some 18% of the accidents were collisions of vehicles engaged in local pickup/delivery operations (accounting for 13% of fatalities, 20% of injuries, 8% of property damage). Noncollision accidents (local pickup/delivery) accounted for 3% of accidents, 1% of fatalities, 2% of injuries, and 3% of property damage.

Bureau of Motor Carrier Safety, Washington, D.C. 20590
1978; 84p
Availability: Corporate author

HS-025 965

GAS AND PARTICLE EMISSIONS FROM AUTOMOBILE TIRES IN LABORATORY AND FIELD STUDIES

Measurements of SBR (styrene-butadiene rubber) in airborne particulate near a freeway (San Gabriel River Freeway, Norwalk, Calif.) demonstrate that most tire wear particles are not suspendable. Tread rubber concentrations ranged from 0.12 mcg/cu m to 0.48 mcg/cu m, figures equivalent to less than 5% of the total wear. Tread rubber accumulation in the soil adjacent to the freeway was equivalent to a depth of less than 0.5 mm. Any mechanism which removes the rubber particles or reduces the amount of SBR in the rubber particles minimizes apparent accumulation. Indoor studies show that the degradation of tire tread during the wear process produces small quantities of gaseous hydrocarbons, such as 1,3-butadiene, isoprene, vinylcyclohexene, p-dipentene, m-dipentene, styrene (monomers and dimers of the SBR copolymer), and sulfur compounds (sulfur dioxide, carbon disulfide, carbonyl sulfide). The emission of the SBR monomers and dimers indicates that local areas of the contact patch experience the thermo-mechanical equivalent of high temperature. Severe polymer degradation and volatilization of extender oil result in aerosol emissions deficient in SBR polymer. Distinct areas of abrasion give rise to most of the tire wear as particles which settle close to the roadway. Gaseous emissions of 2.4 mg/km/car and airborne, particulate emissions of 2 mg/km/car to 5 mg/km/car are negligible compared to other air pollution sources. For example, the hydrocarbon emission rate from tires is less than 0.1% of the current exhaust hydrocarbon emission rate; hydrocarbons from tires are not measurable near a freeway.

by S. H. Cadle; R. L. Williams
Publ: Rubber Chemistry and Technology v52 n1 p146-58 (Mar-Apr 1979)
1979; 17refs
Reprinted from Air Pollution Control Association Journal v28 n502 (1978).
Availability: See publication

HS-025 966

DIURNAL VARIATION IN SUBSIDIARY REACTION TIME IN A LONG-TERM DRIVING TASK

The biological circadian rhythm as a single factor in traffic accidents and driving performance was studied using eight subjects driving in northern Sweden. In each of four sessions, beginning at 0300, 0900, 1500 and 2100, the subjects drove for 3 hr and performed a subsidiary reaction time task (auditory).

Critical confounding factors, such as lighting conditions, traffic intensity, amount of sleep preceding the session, and temperature in the car were considered. The lighting conditions were controlled naturally, i.e. by the midnight sun during which there is almost continual light. Results show that there were small differences in the level of performance among the four sessions, but differences in the rate of performance deterioration were not observed. Results indicate that biological rhythm as a single variable has only a minor influence on driving performance. Consequently, the diurnal rhythm of traffic accidents, as evidenced by accident statistics, must be attributed to other factors, such as long hours of driving and/or sleep deprivation, which culminate during the morning hours.

by Hans-Olof Lisper; Britt Eriksson; Karl-Olov Fagerstrom; Jan Lindholm
Publ: Accident Analysis and Prevention v11 n1 p1-5 (Mar 1979)
1979; 29refs
Sponsored by Transport Res. Delegation.
Availability: See publication

HS-025 967

TRAFFIC ACCIDENTS AND PROFESSIONAL DRIVER CHARACTERISTICS: A FOLLOW-UP STUDY

As a follow-up study to a 1958 analysis of the accident behavior of bus and streetcar drivers in Helsinki, Finland, the accident behavior of 66 of the original 100 in the driver group was followed for driver exposure times ranging from 10.5 yr to 26.5 yr (mean of 16.6 yr working for the Municipal Transport Co.). The consistency of accident coefficients and the prediction power of the test variables (factors related to intelligence, attention, coordination, simple reaction time, involuntary control of motor functions, and stability of behavior) were studied by multiple regression, factor, and discriminant analyses. The correlation between the accident coefficient (accidents per driver per year) of the basic eight-year period and the follow-up period of nine years (average) was 0.56, corresponding to a reliability of 0.72 for the total exposure time. Correlations between the test variables and the accident coefficients for the follow-up period were almost the same size as in the basic period, although the follow-up period ranged from 1 to 20 years from the time of psychological testing. Multiple correlations between the accident coefficient and 18 test variables for the basic, follow-up, and combined periods were 0.75, 0.77, and 0.81, respectively. These and other analyses showed that the accident behavior of professional city drivers is very constant, and that this behavior can be predicted with specially-planned psychological tests.

by Sauli Hakkinen
Publ: Accident Analysis and Prevention v11 n1 p7-18 (Mar 1979)
1979; 12refs
Availability: See publication

HS-025 968

EJECTION AND SAFETY BELTS

Data are presented from a Swiss Federal Dept. of Justice and Police one-year field study initiated in 1976 to investigate injuries to seat belt wearers. The data concern 15 seat belt wearers who were ejected out of a total of 410 belted occupants who sustained an injury severity of Overall Abbreviated Injury Scale 2 or greater. Six of the 15 ejected occupants slipped out of an intact two-point shoulder belt; four cases involved the tearing of

a three-point belt webbing; three cases involved the rupture of a belt anchorage. In 11 of the 15 cases a rollover occurred. Ejection was found to be the most traumatic accident factor in terms of mean Injury Severity Score (45) and death rate (9 of 15 people died). Fractures of the cervical and thoracic spine, especially those with cord damage, were significantly more frequent in ejection cases. Results indicate that the safety of belted car occupants can be increased further if only three-point belts are worn and if they are tightly secured. Two-point shoulder belts which allow the occupants to slip out, and sharp edges inside the car which may cut the webbing considerably reduce the protection offered by a belt system.

by F. Walz; U. Zollinger; P. Niederer
 Publ: Accident Analysis and Prevention v11 n1 p19-22 (Mar 1979)
 1979; 28refs
 Availability: See publication

HS-025 969

PREVENTING MOTOR VEHICLE RELATED BURNS

Results of a 1974-1975 upstate New York survey of hospitalized burns identify motor vehicle-related burns as an important contributor to burn morbidity (8.4% of the total number of hospitalized burn injuries). Males are at higher risk than females, and the age group 15-24 years is at higher risk than the population as a whole. The mean wound size estimated for 253 patients hospitalized in 1975 for motor vehicle-related burns was 10.1% of the body surface area. The most extensive burns (13.9 mean % body surface area) were associated with boats, followed by cars (10.7%), trucks and vans (7.4%), and motorcycles (5.8%). Over half the motorcycle victims sustained some full-depth injury as compared to about one-fourth of car victims, although the burns in the latter group were larger on the average. Boat victims sustained large but not deep burns, possibly related to immediate immersion of the injury in water. Among car-related burns, the most frequent types were scalds (39.5%) and flames (38.7%). Most of the scalds were from radiator boil-overs while the flame burns were most often from fires during carburetor work and from traffic accidents. Contact burns were the most frequent among motorcyclists (43.5%) with exhaust system components often involved, and flame burns were also frequent (33.9%). Flame burns were most frequent in boats (85.2%), and trucks and vans (44.1%). Overall, traffic accidents accounted for 118 or 24% of all motor vehicle-related burns (52% of motorcycle, 22% of car, and 23% of truck/van burns occurring in traffic accidents).

by Mark S. Baptiste; Gerald Feck
 Publ: Accident Analysis and Prevention v11 n1 p23-6 (Mar 1979)
 1979; 8refs
 Availability: See publication

HS-025 970

COMPULSORY SEATBELT USE: FURTHER INFERENCES

On 1 Jun 1972, the wearing of available seat belts by front-seat occupants (drivers and front-seat passengers) became compulsory in New Zealand. A study (by Toomath and Laurenson, 1976) comparing fatality rates during the two years preceding and following the law revealed a decrease of 7% in the fatality rate for front-seat occupants per million gallons of taxable gasoline consumption, accompanied by a surveyed seat belt usage rate increase from 25% to 67%. Considering the well-established

value of seat belts in reducing road trauma, the size of the fatality reduction is rather disappointing. For clarification, fatality rates crudely adjusted for exposure were calculated separately for belted and nonbelted front-seat occupants. Since comparative rates before and after the law were somewhat surprising, a model was constructed in which the after-law use rate could be treated as an unknown. It was found that, based on surveyed use data, the fatality rate for belted and unbelted front-seat occupants increased after the law. Since the composite (belted and nonbelted) gasoline-adjusted front-seat occupant fatality rate decreased, there is an apparent paradox that can be resolved by assuming a qualitative shift in the user population. Inferential analysis suggests that belt use reduced the probability of fatal injury, in a given crash, by about 40%. Similar analysis suggests that the effects of the law, when added to those of voluntary use, saved only about 40% as many lives as could have been saved by universal belt usage among front-seat occupants. Apparently those still not wearing belts after the law represent a particularly high-risk group for whom increased belt use would result in disproportionate savings. The fatality count included a number of belted occupants whose seatbelts were improperly adjusted, torn, or broken loose during the collision.

by Paul M. Hurst
 Publ: Accident Analysis and Prevention v11 n1 p27-33 (Mar 1979)
 1979; 2refs
 Availability: See publication

HS-025 971

ESTIMATION OF NONRESPONDENT BAC [BLOOD ALCOHOL CONCENTRATION] USING A PRIORI JUDGEMENT

Two methods of adjusting for nonparticipation bias in roadside breath testing surveys to evaluate the drinking/driving situation are compared. Method 1 (originally proposed by the author in 1971) uses the assumption that the probability of measured BAC (blood alcohol concentration) level conditional on a priori judgment of drinking is the same for respondents and nonrespondents. Method 2 (Hurst and Darwin, 1977) uses the assumption that the probability of a priori judgment of drinking conditional on BAC level is the same for respondents and nonrespondents. Method 2 yields substantially larger estimated probabilities of high BAC for nonrespondents. Both methods can be supported by sound logical arguments. Method 2 is shown to yield negative probabilities, when applied to a large roadside survey sample, and is thereby rejected. Efforts are recommended to improve the participation level of roadside BAC surveys.

by W. L. Carlson
 Publ: Accident Analysis and Prevention v11 n1 p35-41 (Mar 1979)
 1979; 4refs
 Availability: See publication

HS-025 972

A LABORATORY EVALUATION OF A LOW COST MOTOR VEHICLE CRASH RECORDER

A laboratory evaluation was made of an inexpensive crash-severity measurement device for large scale installation in automobiles to permit untrained investigators to measure crash severities. The device, developed by the Breed Corp. (N.J.), is a simple, viscous-damped, mechanical crash recorder which measures velocity change as the recorded parameter. (Appendixes provide a description, the theoretical basis, and assembly and

calibration of the prototype.) A series of laboratory tests were conducted to determine the performance of a group of 86 prototype recorders over a range of impact speeds and pulse durations, using a miniature sled system specifically designed and constructed for these tests. Results indicate that the concept and design have great potential for application in motor vehicles. Recorders based on this concept should be relatively inexpensive when produced in large numbers (less than \$10). They can meet most of the requirements necessary for motor vehicle applications; they are simple to construct and operate, rugged, tamper-proof, and easy to read following a crash.

by Brian O'Neill; Jackson Wong

Publ: Accident Analysis and Prevention v11 n1 p43-9 (Mar 1979)

1979; 5refs

Sponsored by Insurance Inst. for Hwy. Safety.

Availability: See publication

HS-025 973

THE EFFECTS OF AUTOMOBILE INSPECTIONS ON ACCIDENT RATES

To determine whether diagnostic inspections reduce accidents, a comparison was made of the accident rates of vehicles which participated in the Alabama Motor Vehicle Diagnostic Inspection Demonstration Prog. with those of vehicles which did not. The Alabama project, known locally as Auto Check, was established in 1974 by the National Hwy. Traffic Safety Administration, and involves voluntary driver participants who learn of the program through advertising campaigns. Using data for Huntsville only, it was found that the accident rate of inspected vehicles represents an improvement of 9.1% over the rate for noninspected vehicles. It was also found that the accident rate of inspected vehicles decreased 5.3% after inspection. Whereas the monthly accident rate of the responsive participant who returned for subsequent periodic motor vehicle inspections did not increase significantly in 18 months, the monthly accident rate of nonresponsive participants increased to the level of the noninspected vehicles. Vehicles involved in accidents were in significantly worse mechanical condition on the average than those not involved in accidents. The data suggest that poor mechanical condition is a significant factor in motor vehicle accidents and that annual inspections are a desirable means of reducing accident rates. A copy of the Auto Check diagnostic inspection form is appended.

by Bernard J. Schroer; William F. Peyton

DOT-HS-5-01056

Publ: Accident Analysis and Prevention v11 n1 p61-8 (Mar 1979)

1979; 7refs

Availability: See publication

HS-025 974

DANGER. "OTHER GUYS" AHEAD [KEY TO UNSAFE DRIVERS]

The many guises of the discourteous, careless, distracted, and otherwise unsafe "other driver" are described. It is deemed necessary for the average, self-preserving motorist to augment his own driving skills with an alertness to the moves and attitudes of other drivers. The following types of drivers, driving actions, or driving situations are identified: driving with rear-view mirror not in alignment with driver's eyes, tailgaters who speed behind lead drivers at four-way-stop intersections, badly damaged or souped-up cars, lane wobblers, sports car jockeys

who lunge in and out of high-speed lanes of traffic ("square cornering"), drivers who lean into every turn or corner, steering-wheel jerkers, "door dummies" who carelessly fling open car doors after parallel parking without checking oncoming traffic, "lovebirds", drivers who barge into lanes without signaling or when there is insufficient space, and "road hogs" who have time to kill. Other areas for study by the defensively-motivated driver in the "watch-the-other-fellow" campaign include the station wagon loaded with restless children, the trucker who makes a habit of gawking, coffee drinkers, the blind spot behind the rear fender, young drivers who never use turn signals, and smart-aleck pedestrians. In addition to observing the driving behavior and outward appearance of the other driver, one must speculate upon his mood, health, and present mission.

by Lester F. Ziegler

Publ: California Highway Patrolman v43 n1 p14, 53-4, 57, 59 (Mar 1979)

1979

Availability: See publication

HS-025 975

DEVICES TO PROTECT YOUR CAR FROM THEFT

Removal, breakage, or picking of ignition locks (and sometimes the use of the original key) is pointed out as the means by which most cars are stolen. A unique high-security replacement device for the ignition-lock cylinder, the Lock Technology GML1, is described. The device fits only General Motors, American Motors, and some Chrysler Corp. cars, but the design concept could be extended to all cars. The Lock Technology cylinder is completely recessed in the car's steering-column housing, so that it is inaccessible to any kind of lock-puller. The keyway is surrounded with a hardened steel body, impervious to the screw-in tip of a slide hammer. The lock is virtually unpickable and is protected by strict key control (duplicate keys available only from authorized locksmiths or the manufacturer). The lock lists for \$65 and should be installed by a qualified person (probable charges of \$25 to \$35). Aside from those for the Lock Technology cylinder, test results are presented for various commercial antitheft devices falling into the general types of system-interrupters, alarms, and mechanical locks. The devices are described and rated, the top rating going to the Lock Technology GML1 which was by far the most effective device tested. It is recommended that auto manufacturers insure that the steering-column lock housing is a metal casting strong enough to withstand all physical assaults that might wreck the steering column itself; and that manufacturers install or offer as an option a reliable high-security ignition lock recessed in the steering-column housing. Also, it is proposed that insurance companies offer premium reductions for cars equipped with antitheft devices (already a legal requirement in Massachusetts on comprehensive coverage).

Publ: Consumer Reports v44 n5 p294-9 (May 1979)

1979

Availability: See publication

HS-025 976

A MATHEMATICAL TECHNIQUE FOR PREDICTING EQUILIBRIUM ROLLING RESISTANCE OF TIRES FROM SHORT DURATION TESTS

A technique using an exponential least-squares fit to analyze the behavior of measured nonsteady-state rolling resistance data and to compute the equilibrium rolling resistance force is discussed.

November 30, 1979

HS-025 980

Raw data are filtered analytically to reduce amplitude fluctuations prior to applying the technique. The method has been applied to rolling resistance tests on tires in a free-rolling, straight-ahead condition, under constant velocity and load. The use of the prediction technique is demonstrated for 12 passenger car tires that were tested under equilibrium conditions. A minimum average run length of 24.1 km (15 mi) was required to predict the equilibrium rolling resistance force with a 2% error; the error increases exponentially with decreasing distance.

by C. Brown; I. Gusakov
Calspan Corp., Advanced Technology Center, Buffalo, N.Y.
Rept. No. SAE-790118; 1979; 11p 9refs
Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

feedback-control systems will be necessary in cars equipped with three-way catalytic converters for emission control. Fuel-savings applications of electronics include control of spark timing, idle speed, transmission, and fuel injection. Other fuel-savings developments include automatic transmissions with overdrive gears to reduce engine workloads, and use of synthetic lubricants to reduce powertrain friction losses. The diesel engine's future is problematical because of emissions of particulates and nitrogen oxides.

by Richard L. Waddell
Publ: Ward's Auto World v15 n4 p38-41 (Apr 1979)
1979
At head of title: Special Report: Engines and Engine Components.
Availability: See publication

HS-025 977

THE STRANGE CASE OF THE KNEELING BUS [ACCESSIBILITY FOR HANDICAPPED PASSENGERS]

With so much money already invested in their individual advanced design buses, General Motors Corp. and Grumman Flexible are not interested in bidding for a government contract to build a whole new bus design, the Transbus. The Transbus, says GM, which built prototypes, is too costly and technically unsound. The problem is a revolutionary design that makes the bus more accessible for handicapped passengers; the floor height is 22 in and the bus "kneels" to 18 in for boarding. There is also a front door ramp or wheelchair lift. GM's present advanced bus design is claimed by the company to be comparable to the Transbus except that the latter has one less step, an extra rear axle, and a rear wheelchair lift. The Transbus would cost about \$230,000 a copy vs. \$110,000 for GM's Rapid Transit Series bus. Grumman Flexible says the Transbus is the greatest risk any bus manufacturer could take. Foreign bus manufacturers may bid on the Transbus but no company presently makes a bus meeting Transbus specifications.

by Fern Schumer
Publ: Forbes p41-2 (30 Apr 1979)
1979
Availability: See publication

HS-025 978

THE AGING RECIP STILL PACKS A WALLOP [INTERNAL COMBUSTION RECIPROCATING ENGINES]

The extensive technical and mechanical improvement investment in the internal combustion reciprocating engine (ICRE), both gasoline and diesel, by the U.S. auto industry indicates the stronghold the piston engine maintains in comparison with challenging powerplants. Under the constraints of getting more power from less space (for improved fuel economy), Detroit engineers are having to design smaller engines with components designed to do double duty. Turbocharging to boost power and performance of fuel-efficient smaller engines will be increasingly used. Turbocharging involves higher loads on the bearing face of piston rings, necessitating better oil seals and higher strength for the basic top rings. The new small engines can shed weight to boost efficiency by increasing hp-to-weight ratios; one example is the use of stamped-metal (high-strength steels) engine parts ordinarily made of cast iron or aluminum. Another area of innovation for engines of the 1980's is the redesign of the combustion chamber to obtain better flame propagation. Electronic

HS-025 979

DIAMOND INTERCHANGE TRAFFIC SIGNAL CONTROLLER. AN AID TO THE PREPARATION OF PROCUREMENT SPECIFICATIONS FOR MICROPROCESSOR BASED SIGNAL CONTROLLERS

The flexibility, low cost, and ease of use are reported for the Type 170 traffic signal controller, the specifications of which were developed jointly by the states of California and New York as a user-oriented controller specification. The 170 microcomputer-based controller is compared to the minicomputer equipment and to the hardwired equipment for diamond-interchange control to demonstrate its capability. The user orientation of the controller is explained, and the three alternatives of microcomputer control, minicomputer control, and hardwired equipment control are compared to demonstrate that microcomputer controllers such as the 170 are the logical choice. The logic behind the design of the 170 hardware and its use of proven technology are explained as are the cost-effectiveness and benefits of the 170 design. Software considerations such as man-machine interface features are described briefly. It is recommended that the 170 controller be considered as a standard controller for all traffic signal control applications; it is so specified by the states of California and New York. A copy of the 170 specification is attached.

by L. Kubel; G. Bloodgood; F. Workmon
California Dept. of Transportation, Div. of Highways, 1120 North St., Sacramento, Calif. 95814
DOT-FH-11-8250
Rept. No. FHWA-TS-78-228; 1978; 41p 6refs
Cover title: "The California/New York Type 170 Traffic Signal Controller System--Microcomputer Based Intersection Controller."
Availability: NTIS

HS-025 980

DESIGN, ART AND ARCHITECTURE IN TRANSPORTATION. FIRST ANNUAL REPORT TO THE SECRETARY OF TRANSPORTATION

Progress is summarized for the first year of implementation of the Secretary of Transportation's announced policy to encourage good design, art, and architecture in transportation facilities and services. Since 1 Sept 1977, when the program was announced, the Federal Aviation Administration (FAA), the Federal Railroad Administration (FRA), the Urban Mass Transportation Administration, and the Coast Guard all have established formal policies on the eligibility in transportation project costs

of original works of art and improved design and architecture, and funds have been set aside for specific FRA and FAA projects. Several research and development projects are underway; in training, a Federal Hwy. Administration course has been presented in nine cities to 229 highway professionals; FAA has almost completed development of a slide/tape presentation and handbook to encourage better design of airport facilities. The Dept. of Transportation (DOT) order on environmental impact statements has been revised to require greater consideration of design and aesthetics in projects, and to include the design and arts community in the consultation process. FAA is revising its selection process for consultants for airport development and planning, to incorporate aesthetic awareness as one of the selection criteria. A major four-phase graphics improvement program is underway at DOT with the assistance of a consulting firm. The Charter has been approved for the continuing DOT Task Force on Design, Art and Architecture in Transportation. A small level of staff support for overseeing and coordinating the overall program has been established in the Office of Environment and Safety. (The Secretary of Transportation's statement on design quality, and various agencies' documentation related to program implementation are appended.)

Department of Transportation, Task Force on Design, Art and Architecture in Transportation, Washington, D.C. 20590

1978; 72p refs

Availability: Corporate author

HS-025 981

MOTORCYCLE AND BICYCLE ACCIDENTS

Use of conspicuous clothing and equipment and of headlights during the day by motorcyclists, motorist alertness to motorcyclists, and motorcycle training programs all can contribute to preventing motorcycle accidents. Crash helmets reduce the risk of serious and fatal head injuries, but there is room for improvement in their present design. In the severest impacts where the use of a helmet could not prevent injury, a device to lessen the impact violence is required (e.g. an energy-absorbing chest pad fixed to the vehicle, air bags). Leg injuries account for some 70% of all motorcycle injuries, and devices for protecting the legs would be beneficial. Mopeds appear to be less prone to give rise to fatal accidents than other two-wheeled motor vehicles. Many bicycle accidents involve heavy trucks, the situation often involving a bicyclist in the driver's blind spot. The greatest involvement in bicycle accidents is among children. There are limitations to training young cyclists about road safety, as a child's main concern is playing. The behavior of young cyclists must be expected to be at least unpredictable. For child cyclists, and pedestrians, the surest way to reduce accidents is to limit their traffic exposure. Safe play areas would help, but parents should be persuaded to consider carefully at what age and to what extent they should encourage their children to cycle unsupervised. The dangers of cycling in traffic must be made real to children, and motorists need to be more bicycle-conscious. Conspicuous clothing and helmets worn by cyclists would be helpful. Everywhere, planners and traffic engineers should give more thought to cyclist needs.

Publ: British Medical Journal v1 n6155 p39-41 (6 Jan 1979)
1979; 28refs

At head of title: A Modern Epidemic.

Availability: See publication

HS-025 982

ACCIDENTS--SPEED AND THE ROAD ENVIRONMENT

Speeding, even with the best drivers, allows a smaller margin of error; and when high-speed accidents do occur, they are far more serious and often fatal. Drivers in Britain were unusually motivated to keep within the lower speed-limit periods during the fuel crisis of 1973-1975; they wanted to conserve fuel because of the shortage and increased cost. Existing speed limits in the U.K. are widely ignored, especially those unrealistic in terms of traffic and road conditions. A survey of male drivers found that they accepted speed as a cause of accidents but deemed speeding a nonserious offense. Although the posting of more speed limit signs might not reduce speeds, the greater use of advisory speed signs to denote hazardous areas might be productive. External devices for influencing driver speed are helpful, such as the use of a pattern of lines at decreasing intervals along the road to create a visual illusion of increasing speed, "rumble areas", speed-control bumps on residential roads, and electronic sensing devices on cars to transmit information on speed changes to following vehicles. Low-cost schemes for improved traffic management can produce remarkable results at dangerous junctions, where over half of all urban injury accidents in Britain occur. Examples of low-cost countermeasures include making the hazard more noticeable by placing an island a little left of center in the minor road, use of hatch markings, changes to traffic lights, skid-resistant eliminating obstructions. Not only must road signs be conspicuous and unambiguous, the information should be presented in simple stages and at the right moment. Installation of lighting (breakaway-type posts preferable) is important in accident reduction. Antidazzle fencing and automatically-adjusting headlights are useful in reducing the glare problem. Various solutions have been proposed for the fog problem; the best advice is to avoid traveling at such times.

Publ: British Medical Journal v2 n6152 p1619-21 (9 Dec 1978)
1978; 27refs

At head of title: A Modern Epidemic.

Availability: See publication

HS-025 983

ADHESION OF ELASTOMERS TO POLYESTER

Tenacious rubber-to-fabric bonding, considering the array of new fibers and elastomers coming into existence, depends on a combination of mechanical forces, chemical interactions, and thermodynamic compatibility. The concept of employing graduated physical properties for optimizing mechanical adhesion has been demonstrated for bonding rubber to fabric. In adhering SBR to a woven unscoured polyester, an aqueous adhesive has been used over latexes having varying glass transition temperatures. Mechanical adhesion alone, however, is not always commercially efficient nor does it necessarily provide for environmentally-resistant adhesion. These parameters can be optimized with adhesives that integrate chemical functionality, such as resorcinol-formaldehyde-latex (RFL) adhesives which react chemically with rayon and nylon. Polyester and polyaramic fabrics do not readily lend themselves to chemical interactions. A proper modification can improve the thermodynamic compatibility between the substrate and adhesive. Hughson Chemical has developed a combination aqueous adhesive (TS-3563-5), polyester (TS-3563-3) pretreatment which bridges the thermodynamic compatibility differential. The best information to date suggests that TS-3563-3 is able to interact with the polyester fabric via hydrogen bonding, either singularly with each carbonyl group or via a polymeric hydrogen-bonded structure.

November 30, 1979

HS-025 987

by Eugene L. Polaski
Publ: Elastomerics v111 n4 p19-21 (Apr 1979)
1979; 4refs
Availability: See publication

HS-025 984

FURTHER APPLICATIONS OF TREATED CELLULOSE FIBERS AS A RUBBER REINFORCEMENT

Santoweb, Monsanto's proprietary short cellulose fiber reinforcement material, because of its anisotropic effect allows manufacture, in combination with high composite bonding levels, of "one-step" rubber articles with such desirable properties as low elongation at break, high modulus, high hardness, and high green strength. A compound used for conveyor belting can have its cut growth resistance doubled by using one of the four commercially-available grades of this rubber-reinforcing material, Santoweb DX. A strip cut from a calendered sheet containing Santoweb can be used on the liner of a wrapped vacuum hose instead of a textile layer; the resulting hose will be less expensive and more flexible. A die developed by Monsanto enables the conventional axial orientation of the fibers to be changed to the desired circumferential direction during extrusion; it is usable on a variety of extruder types and in a range of screw sizes. A number of rubber (EPDM, SBR, NR/SRB, NBR) formulations containing Santoweb have proved to meet performance specifications for such applications as water and gas hoses, fuel hoses, and automotive radiator and heater hoses, both straight and shaped. Composite fiber reinforced calendered stock can be used in V-belt base compounds, and assembled into belts so that the fibers are oriented transversely to the belt's direction of travel. The stiff stock supports the belt's tension members and prevents premature failure; at the same time, the low modulus in belt travel direction permits greater flexibility.

Publ: Elastomerics v111 n4 p30-1 (Apr 1979)
1979; 3refs

Based on a paper, "Industrial Applications for Short Cellulose Fibre Reinforced Rubber," by J. M. Campbell, G. Anthoine, J. Stemper, and K. Boustany, presented at International Rubber Conference, Kiev, 10-14 Oct 1978.
Availability: See publication

HS-025 985

JOAN CLAYBROOK [INTERVIEW ABOUT MOTORCYCLING]

A shortened version of a one-hour personal interview with the head of the National Hwy. Traffic Safety Administration (NHTSA) is provided; it is pointed out that editing was carefully done in order to maintain the context and facts of the discussion while accurately reflecting the attitude and style of the NHTSA administrator. (Purchasing information is supplied for a complete transcript of the taped interview.) Questions posed to Ms. Claybrook cover the following topics: personal transportation in the U.S. in the next 20 years; traffic safety measures and personal freedom; mandatory motorcycle helmet use laws; NHTSA's front-wheel drive, rear-wheel steering Experimental Safety Motorcycle; measures aimed at motorists to treat motorcyclists more humanely; feedback to NHTSA about motorcyclists' opinions; Ms. Claybrook's personal view of motorcyclists; and mandatory seat belt use laws. (Editor's notes accompany the question/answer text.)

Publ: American Motorcyclist v33 n4 p22-3, 26-7, 30 (May 1979)
1979; 1ref
Availability: See publication

HS-025 986

HAZARDOUS EFFECTS OF HIGHWAY FEATURES AND ROADSIDE OBJECTS. VOL. 1: LITERATURE REVIEW AND METHODOLOGY. FINAL REPORT

A literature review and the methodology for data collection and preparation for analysis are provided for a study to determine hazards in run-off-road accidents. The major data sources were accident data from specially-trained state police, and road and roadside data from state files. Data from almost 8000 accidents on rural roads were collected in six states (California, Georgia, Maine, South Dakota, Tennessee, Wyoming). The major aim of the study was to identify road and roadside hazards and their effects on accident generation and resultant injury. The literature survey separately covers characteristics of vehicle departures in run-off-road accidents, effects of highway and roadside geometrics on accidents, effects of roadway characteristics on driver behavior, and possible countermeasures for highway hazards. Methodology is discussed in terms of data collection plan, highway data collection and coding procedures, accident data collection/coding, and data processing procedures.

by Kenneth Perchonok; Thomas A. Ranney; A. Stephen Baum; Dominic F. Morris; J. Douglas Eppich
Calspan Field Services, Inc., P.O. Box 400, Buffalo, N.Y. 14225
DOT-FH-11-8501

Rept. No. FHWA-RD-78-201; CAL-ZR-5564-V-1; 1978; 127p
92refs

Vol. 2, Findings, is HS-025 987.

Availability: NTIS

HS-025 987

HAZARDOUS EFFECTS OF HIGHWAY FEATURES AND ROADSIDE OBJECTS. VOL. 2: FINDINGS. FINAL REPORT

Results are presented of a study concerning the role of roadway and roadside features in generating single-vehicle accidents and influencing the severity of those accidents. The major data sources were accident data from specially-trained state police, and road and roadside data from state files. Data from almost 8000 accidents on rural roads were collected in six states (California, Georgia, Maine, South Dakota, Tennessee, Wyoming). Findings reflect the sample descriptors; factors influencing the occurrence of run-off-road accidents; characteristics of road departures and factors influencing them; off-road events and factors influencing them, including the effects of offset and clear zones; impact behavior, speed, area of damage, and objects struck; effects of impact characteristics on severity; and effects of driver, road, maneuver, departure, and roadside characteristics on severity. In addition, there were a number of special studies including the role of impact characteristics in the relationships between severity and ditch depth, border offset, horizontal alignment, and degree of curvature. Also studied were guardrail and culvert impacts, extent of damage and injury relationships, and average daily traffic vs. accident rate. Countermeasures are discussed in terms of classification, costs, needs, and current practice.

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DOT-FH-11-8501

Rept. No. FHWA-RD-78-202; CAL-ZR-5564-V-2; 1978; 336p
Vol. 1, Literature Review and Methodology, is HS-025 986.

Availability: NTIS

HS-025 988

ENERGY CONSERVATION WITH INCREASED COMPRESSION RATIO AND ELECTRONIC KNOCK CONTROL

Results of tests are reported on the application of an electronic closed-loop knock control system to a higher compression ratio (CR) engine to allow operation on 91 Research Octane Number fuel. Two cars with different CR's are compared with both oxidizing converter-exhaust gas recirculation (EGR) and 3-way oxidizing-reducing converter-EGR closed-loop carburetor emission control systems. These tests illustrate that the knock control system only retards when required due to operating conditions and, therefore, permits fuel economy gains under the majority of driving conditions. It is expected that other engines may require more or less retard to control knock at higher CR's, depending on such design parameters as combustion chamber, fuel control system, emission control system, or cooling system. Application of the knock control system would, therefore, require thorough testing to determine the fuel economy advantage with each engine family and the maximum CR which can be used within the design constraints of the knock control system.

by James H. Currie; David S. Grossman; James J. Gumbleton
General Motors Corp., Engineering Staff
Rept. No. SAE-790173; 1979; 13p 7refs
Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 989

HALOGEN SEALED BEAM HEADLIGHTS

The history and practical applications of halogen lamps are traced from 1912 to the present halogen sealed beam headlamps that are available on numerous 1979 model automobiles. The terminology related to halogen-cycle lamps and the chemical/thermal cycle phenomena are explained for the automotive lighting engineers and references will allow researchers to review previous work. The new halogen sealed beam headlamps will provide the motorist with a greater choice of headlighting performance while retaining the superior features of sealed construction, mechanical aiming, lighting distributions designed for U.S. roadways and replacement units available from over 400,000 retail outlets in the U.S. The consumers' selection will be of interest to the five domestic and two foreign sealed beam manufacturers, and to the motor vehicle manufacturers. The new halogen sealed beam headlamps may be the initial step toward evolutionary new headlamp designs, involving new materials and new manufacturing processes to meet the changing needs of the automotive industry and society. Appended is an English translation of the report entitled "Headlamps: There is Room for Improvement" from the German TUVAUTO Report '78.

by Ralph A. Ehrhardt
General Electric Co., Miniature Lamp Dept.
Rept. No. SAE-790200; 1979; 14p 21refs
Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 990

A TEST TRACK COMPARISON OF FUEL-ECONOMY ENGINE OILS

A fuel economy track test comparing two experimental oils (SAE 10W-30 mineral oil base, "7-1/2" W-30 with 10% synthetic) to two commercial fuel-efficient engine oils (SAE 10W-40, synthetic SAE 5W-20) was conducted in 1978 compact sedans. Three of the test lubricants consistently provided a significant decrease in fuel consumption compared to one of the commercial fuel-efficient lubricants (SAE 10W-40). All four test lubricants provided the most improvement in fuel economy after the first 2400 km (1500 mi). An experimental formulation from the track test was used as a reference to explore the effects of performance additive, viscosity improver, and viscosity grade on fuel economy. The comparisons were made in different makes of cars using modified Environmental Protection Agency fuel economy procedures. Performance additive and viscosity improver selection directionally reduced fuel consumption in the test cars. The response to viscosity grade changes was not consistent among the test vehicles.

by J. E. Riester; W. B. Chamberlin
Lubrizol Corp., Res. Dept.
Rept. No. SAE-790213; 1979; 14p 4refs
Technical Paper Series. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 991

DIESEL ENGINE NOISE CONFERENCE PROCEEDINGS

Thirty papers discuss the following aspects of automotive diesel noise: problems and developments in engine noise research, review of basic design principles for low-noise engines, a new method for direct determination of combustion noise, reducing knock via exhaust gas recirculation, acceleration noise of direct-injection engines, relationship of combustion system and engine noise, establishing a target for combustion noise control, influence of piston movement on engine noise, influence of mountings on injection-pump noise, coherence model for piston-impact-generated noise, modeling of vibration transmission to reduce noise, vibration mode analysis for noise control, modeling engine noise using coherence, reduction of transmission noise using holographic source identification and constrained-layer damping, computer-optimized engine design for low noise, relationship of crankshaft torsional vibration and engine noise, engine noise reduction by structural design using advanced experimental and finite-element methods, an approach to a quiet car diesel engine, a survey of passenger car noise levels, an experimental passenger car diesel engine, effect of structural design on high-speed engine noise, aspect of noise reduction on diesel passenger cars, experimental study of a high-speed engine by acoustical power method, practical investigation of diesel car noise reduction, concept for chassis-mounted capsule of engine and gearbox for heavy trucks, research project for noise reduction of truck diesel engines, noise emission of air-cooled engines and trucks, Transport and Road Res. Lab. quiet heavy vehicle project, statistical approach for diesel engine noise analysis, and application of acoustic intensity measurement to engine noise evaluation.

Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pa. 15096
Rept. No. SAE-P-80; 1979; 351p refs
Includes HS-025 992--HS-026 021. Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.
Availability: SAE

HS-025 992

PROBLEMS AND DEVELOPMENTS IN AUTOMOTIVE ENGINE NOISE RESEARCH

The requirements for internal combustion reciprocating engines to meet present and future noise regulations (European Economic Community levels) according to their specific road vehicle applications are reviewed critically. The significance is examined of the vibration characteristics of structural elements in relation to the combustion systems employed (opposed piston two-stroke engines, two-stroke DI (direct-injection) engines, DI normally-aspirated engines, DI-type IDI (indirect-injection) normally-aspirated engines, IDI engines with constant pressure combustion, turbocharged DI and IDI engines, gasoline engines). An attempt is made to identify the importance of the balance between mechanically- and combustion-induced noise in specific categories of engines. The combustion system to a great extent predetermines the basic engine design and is largely responsible for determining whether the engine will be controlled by combustion or mechanical noise. The exact relationship between these two sources, despite the enormous quantity of theoretical and analytical work conducted, remains unresolved. Control of engine noise by external structural redesign holds some promise, but the influence of internal structure is at present a limitation.

by T. Priede
University of Southampton, Inst. of Sound and Vibration Res.,
Hants., England
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p1-15
Rept. No. SAE-790205; 1979; 15refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979.
Availability: In HS-025 991

HS-025 993

A REVIEW OF BASIC DESIGN PRINCIPLES FOR LOW-NOISE DIESEL ENGINES

In accordance with the main efforts of research and development in noise control of diesel engines, measures which are essential for a noise reduction of more than 10 dB(A) and results achieved with an advanced direct-injection (DI) combustion system are described. In general, the noise of external engine parts can be reduced to a large extent only by vibration isolation or sound-reducing shells. Considering economic aspects, the attenuation of total engine noise by more than 10 dB(A) requires a complete encapsulation of the engine which can, with newly designed engines, be at least partly integrated into the engine structure. Different approaches developed in the last decade for low-noise engines based on the basic principles of sound-reducing shells are discussed. Specific measures applied to the advanced DI combustion system are discussed which have resulted in equivalent exhaust emissions and acceptable combustion noise as compared with optimized indirect-injection (IDI) systems, while maintaining a 15% lower fuel consumption. Also, with light-duty diesel engines, the same power output and speed as with optimized IDI systems can be achieved.

by Gerhard E. Thien
AVL Prof. List G.m.b.H., Graz, Austria
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p17-37
Rept. No. SAE-790506; 1979; 31refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979.
Availability: In HS-025 991

HS-025 994

A NEW MEASURING METHOD FOR THE DIRECT DETERMINATION OF DIESEL ENGINE COMBUSTION NOISE

Following a review of previous indirect methods of determining diesel engine combustion noise (comparison between a fired engine and a motored engine, spectrum of cylinder pressure curve, 2nd differential quotients of cylinder pressure in terms of time, and solid-borne noise signal at a measuring point near cylinder head), a direct method for such noise measurements is described and applied. The new method, the time-frequency-windows method, involves the recording and analysis of the sound pressure impulse produced by the cylinder pressure during combustion. A sound pressure time signal picked up by a microphone is used without applying a frequency filter. A part of this noise signal is cut out for further treatment by a time window of 20 ms which covers the range near combustion TDC (top dead center position of piston) and includes the combustion noise. It is only from this cut-out signal period that a narrow band spectrum is established with the aid of a digital Fourier analyzer. Similar to quantitative time-frequency analysis, the highest level for each frequency band is used to determine the combustion noise. Steady-state and transient conditions of a single-cylinder, direct-injection diesel engine are evaluated by the new procedure. The method is applicable to bench tests of one- to four-cylinder engines; for higher-cylinder engines, additional measures must be taken (e.g. partial encapsulation of engine).

by F. F. Pischinger; K. P. Schmillen; F. W. Leipold
Technical Univ. Aachen, Inst. of Applied Thermodynamics,
Aachen, Germany; Daimler-Benz A.G., Stuttgart, Germany
Publ: HS-026 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p39-48
Rept. No. SAE-790267; 1979; 5refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979.
Availability: In HS-025 991

HS-025 995

REDUCING DIESEL KNOCK BY MEANS OF EXHAUST GAS RECIRCULATION

The different impacts of lubricant viscosity, ambient and engine temperatures, quantity of fuel injected, compression ratio, and injection timing on diesel engine cold knock were studied experimentally and analytically. Exhaust gas recirculation (EGR) was selected for special study because of its practicality as a means of attaining higher temperatures at ignition point. EGR appears to be a comparatively inexpensive way of reducing cold knock, and in any event, may be required because of emission standards. The effect of EGR on diesel knock is not due to a reduction in ignition delay, which would be a temperature phenomenon, but to a flatter combustion pressure gradient. The EGR rates required to reduce engine noise are high, varying between 25% and 60% of the intake gas quantity. These high rates are possible because diesel engines run at very high equivalence air/fuel ratios when idling.

by H. Oetting; S. Papez
Volkswagenwerk A.G., Germany
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p49-59
Rept. No. SAE-790268; 1979; 10refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979.
Availability: In HS-025 991

HS-025 996

DI [DIRECT INJECTION] DIESEL BECOMES NOISIER AT ACCELERATION. THE TRANSIENT NOISE CHARACTERISTIC OF DIESEL ENGINE

An acceleration mode in measuring vehicle pass-by noise was simulated on an engine test bed in an anechoic room. The accelerated running noise of various types of diesel engines was measured and compared with the steady running noise. The measurement results show that naturally-aspirated DI (direct-injection) engines become noisier at acceleration, while IDI (indirect-injection) engines change only slightly. In turbocharged DI engines, the response lag of the turbocharger causes an especially big noise level difference immediately after acceleration start. It was shown that an increased ignition delay in accelerated running of DI engines is a major cause of an increase in maximum rate of cylinder pressure rise, with a consequent higher noise level. A study of volumetric efficiency and cylinder head wall temperature in accelerated and quasi-steady running showed no substantial difference between the two running states for the former factor but a lower temperature for the latter during acceleration (lower temperature a factor in increasing ignition delay). At the same wall temperature, the noise level in constant-speed running was found to be much lower than that in accelerated-running, indicating that injected-fuel quantity also has an effect on combustion noise.

by Yoshito Watanabe; Hideaki Fujisaki; Toyohiro Tsuda
Nissan Diesel Motor Co., Ltd., Ageo, Saitama, Japan
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p61-72
Rept. No. SAE-790269; 1979; 5refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.
Availability: In HS-025 991

HS-025 997

RELATION BETWEEN COMBUSTION SYSTEM AND ENGINE NOISE

From measured overall internal combustion engine noise levels and corresponding measured combustion (cylinder pressure) levels, the major influence that the combustion system has on the engine-radiated noise is demonstrated. The basic "noisiness" of normally-aspirated two-stroke diesels, normally-aspirated DI (direct-injection) four-stroke diesels, normally-aspirated ID (indirect-injection, or swirl chamber) diesels, turbocharged two- and four-stroke diesels, and gasoline engines are compared by a normalized frequency spectrum method. Using a simple linear model for calculating the direct combustion noise level of each combustion system, the relative levels of noise are determined. Results show good agreement with measured noise levels for normally-aspirated two- and four-stroke DI engines and indicate that combustion noise is low in turbocharged diesels, IDI diesels, and particularly in gasoline engines.

by D. Anderton
University of Southampton, Inst. of Sound and Vibration Res., Hants., England
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p73-87
Rept. No. SAE-790270; 1979; 16refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979.
Availability: In HS-025 991

HS-025 998

ESTABLISHING A TARGET FOR CONTROL OF DIESEL COMBUSTION NOISE

The origins of noise in diesel engines and approaches to noise control at the various sources are discussed; and minimum practicable levels of combustion and mechanical noise which might be achieved are estimated for direct-injection engines of 1 liter cylinder capacity, as used in trucks and tractors of European manufacture. Noise radiated by the engine surface originates from compression, combustion, and expansion, from transient pressures acting on the cylinder head and the piston top face (combustion noise), and from piston slap against the cylinder wall. Timing gear rattle, fuel injection pump torque reaction applied to the engine structure, and inertia forces due to acceleration of the piston and the connecting rod applied to the main bearings also contribute to diesel engine noise. A comparison of the minimum practicable levels of noise with targets derived from proposals for more stringent noise legislation shows that the latter may be achieved by a combination of combustion and mechanical noise control at source and reduction of the engine structure response to these sources.

by M. F. Russell; E. J. Cavanagh
Lucas CAV Ltd., London, England
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p89-101
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HS-025 999

PISTON MOVEMENT AND ITS INFLUENCE ON NOISE OF AUTOMOTIVE ENGINES

A comparison is made of calculated and measured piston transverse movement in a spark ignition engine. The movements at the bottom end of the piston skirt do not conform completely while there is very satisfactory conformity of top skirt movements. The assumption of movements during cylinder wall contact due to skirt elastic deformation is confirmed. The variable movement of the piston during contact is caused mainly by skirt flexibility and to some degree by cylinder wall distortion. The measured velocities of the side changes are generally lower than those calculated. The induction of engine vibrations by piston slap is studied by measuring the lateral forces at the piston skirt during the impact on the cylinder. The application of a piston movement computer program for piston development is demonstrated in the case of engine noise due to piston top land slap. The pressure differences in the main combustion chamber of an indirect-injection diesel engine are measured, and the effect on the piston attitude is analyzed. Examples of low noise piston design for diesel engines are presented. For the common case of the prechamber being located at the minimum thrust side, no piston pin offset is recommended for low noise.

by W. Sander; W. Steidle; E. Wacker
Karl Schmidt G.m.b.H., Neckarsulm, West Germany
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p103-113
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HS-026 000

THE INFLUENCE OF MOUNTINGS ON INJECTION PUMP NOISE

The noise-generating mechanisms of inline fuel-injection pumps are outlined, indicating how these may be affected by future more stringent legal limits on exhaust emissions (European Economic Community regulations). The techniques used to measure pump-radiated noise in the laboratory and on running engines are discussed in detail, with results for both large and small inline fuel-injection pumps provided. A technique for calculating pump-radiated noise from surface vibration, improved to give reliable measurements when a pump is driven by a running engine, was used to compare the noise radiated by a flange-mounted Minimec pump (Lucas CAV Ltd.) on a truck engine with the noise from a base-mounted Minimec on an engine of similar size and rating. The pumps are driven by a hydraulic motor on the stationary engines, as well as by the usual drive arrangement from the engines when they were running. The differences between the noise radiated from flange-mounted pumps and base-mounted pumps were considerable. Even after the influences of driveline backlash and engine vibration had been removed by employing the hydraulic drive to motor the same pump in the two mountings on the same stationary engine, there remained a difference. It was indicated that the pump-radiated noise, due to vibration excitation originating within the pump, was less in the base-mounted than in the flange-mounted configuration.

by M. F. Russell; H. L. Pullen
Lucas CAV Ltd., Lucas Industries Noise Centre, Acton, Mddx., England; Southampton Univ., Inst. of Sound and Vibration Res., Hants., England

Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p115-24
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HS-026 001

A COHERENCE MODEL FOR PISTON-IMPACT GENERATED NOISE

An experimental study was conducted to investigate piston-impact-generated noise in diesel engines. A coherence model was used to represent the noise generating mechanisms of the engine. The model was applied to an in-line turbocharged diesel engine. Frequency response functions were measured between the cylinder liner vibration and the engine noise, and between the combustion pressure and the engine noise. The noise coherent with piston impacts was separated from the noise coherent with combustion. It was found that the engine structure responds most strongly over a wide frequency range from 500 Hz to 3000 Hz; piston-impact vibration occurs mainly in the 1000 Hz to 3000 Hz frequency range. Guidelines are presented showing how the results of the coherence model may be used for engine design and noise prediction.

by P. A. Hayes; A. F. Seybert; J. F. Hamilton
Cummins Engine Co., Columbus, Ind.; University of Kentucky, Dept. of Mechanical Engineering, Lexington, Ky.; Purdue Univ., Dept. of Mechanical Engineering, West Lafayette, Ind.
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p125-32
Rept. No. SAE-790274; 1979; 33refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar 1979. Research sponsored by Cummins Engine Co.
Availability: In HS-025 991

HS-026 002

MODELING OF VIBRATION TRANSMISSION IN ENGINES TO ACHIEVE NOISE REDUCTION

The vibration transmission in engine structures has been studied to develop analytical models which predict changes in the noise-related vibration of the engine as a function of design changes in the engine components. The models are based on vibration measurements made on nonrunning engines. The basic procedures for the necessary vibration measurements and for the development of the models are outlined. Two examples are given of models developed for different vibration transmission paths in different engines. The vibration transmission from the cylinder pressure to the engine block is modeled for a four-cylinder direct-injection diesel engine and compared with a simulated vibration transmission measurement with the engine not running. The vibration transmission from the engine block to covers and shields is modeled for a six-line diesel and compared with the measured vibration transmission with the engine running.

by R. G. DeJong; J. E. Manning
Cambridge Collaborative, Cambridge, Mass.
DOT-TSC-1013

Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p133-43
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HS-026 003

VIBRATION MODE ANALYSIS FOR CONTROLLING NOISE EMISSION FROM AUTOMOTIVE DIESEL ENGINE

An investigation of the vibration of an automotive diesel engine was undertaken for the purpose of obtaining a lower level of noise emission. Measurements of vibration and sound level radiated from the engine surface (using the oil sump as the component) showed a close relationship. Measurements of the vibration of the engine structure (using the timing gear cover) for several running conditions showed the vibration distribution to be of a natural vibration mode, a result in agreement with that obtained by modal analysis. A new method for vibration mode analysis of an engine component which is influenced by cylinder pressure during combustion was applied using the cylinder block. Because of the difficulty in measuring the vibration mode due to the high mechanical impedance and the large damping factor of such a component, modal analysis with a Fourier analyzer was utilized. The results of the vibration analysis of the cylinder block were verified by comparison with the mode shape obtained by an impulse-frequency response technique. The results indicated that reinforcement of the lower side of the cylinder block would be effective for controlling vibration. Attachment of an underplate to the cylinder block caused a decrease in vibration velocity but was not effective in reducing engine noise. It is concluded that the effect of vibration control is influenced largely by the damping factor of the component itself. A formula for determining noise attenuation by damping treatment is presented.

by Fujio Aoyama; Shinichi Tanaka; Yasuo Miura
Hino Motors, Ltd., Japan
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p145-53
Rept. No. SAE-790361; 1979; 10refs
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HS-026 004

HS-026 004

MODELING OF DIESEL ENGINE NOISE USING COHERENCE

The uses of a coherence model (multiple-input, single output system) of diesel engine noise are discussed, with mention of some of the practical difficulties, as well as simplifying assumptions which must be made. Results of various research using the model to study diesel engine noise demonstrate its usefulness. The model can be used to separate the noise from each cylinder. It can be used to provide theoretically a parametric study of the dependence of engine noise on cylinder pressure-time history. The coherence model has shown for the first time the quantitative relationship which exists between the engine noise and the abrupt pressure noise occurring at detonation. The model has allowed a rigorous determination of the attenuation between individual cylinder pressures and engine noise. It has allowed a separation of the noise from combustion and piston slap with a running engine. Although the model so far has been used on engines which are "combustion-noise"-dominated, in principle it also can be used on engines which also have a considerable amount of "mechanical noise", provided the sources of mechanical noise can be identified and measured. Using idealized experiments with loud-speakers it has been shown that the coherence model can be applied in principle to the identification of the noise sources on the vibrating surfaces of machines such as diesel engines. In practice so far, such experiments with real engines and large multiple sources such as trucks seem to have been mainly unsuccessful.

by Malcolm J. Crocker; James F. Hamilton
Purdue Univ., Ray W. Herrick Labs., West Lafayette, Ind.
47907

Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p155-65
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HS-026 005

TRANSMISSION NOISE REDUCTION USING HOLOGRAPHIC SOURCE IDENTIFICATION AND CONSTRAINED LAYER DAMPING

A test program was undertaken to identify and modify critical areas of the transmission housing that act as speakers, in an effort to produce a quieter transmission. The housing selected for study was a transfer gearbox from an Allison CLBT-750 transmission used in off-highway scrapers and trucks. A photographic technique using laser light, called Double-Pulsed Holography, offered a unique means of visualizing housing surface vibrations. The study consisted of the following five phases: an initial noise test to establish a noise baseline and its frequency spectrum, a holography test to identify areas of the housing with high vibrations, an accelerometer test to verify that the housing vibration-frequency spectrum is related to the sound-frequency spectrum, redesign or treatment of the housing in the areas identified using holography, and a final noise test to evaluate the effectiveness of changing the housing. The program has resulted in a quieter prototype through use of constrained-layer damping materials at critical housing points.

by Ronald W. Hera

General Motors Corp., Detroit Diesel Allison Div.
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p167-74
Rept. No. SAE-790363; 1979; 6refs
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HS-026 006

COMPUTER OPTIMISED DESIGN OF ENGINE STRUCTURES FOR LOW NOISE

A description is presented of a computer optimization procedure, using static deflection techniques, by which the overall noise level of an engine can be reduced by up to 5dB(A) with minor modification. The computer program operates with given weight, space, and strength constraints and produces a modified design which can be machined by existing equipment. The use of the static deflection technique is justified by results of running-engine damping measurements and by analysis of the influence of damping on typical third octave vibration levels. This analysis demonstrates that the damping of the block structure has very little influence on running engine vibration levels, which are, in fact, controlled by the stiffness.

by N. Lalor

University of Southampton, Inst. of Sound and Vibration Res.
Hants., England

Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p175-83
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HS-026 007

RELATION BETWEEN CRANKSHAFT TORSIONAL VIBRATION AND ENGINE NOISE

Results are presented of investigations into the mechanism of radiated noise from an acoustically-modified diesel engine. The overall noise level of this engine is quite low compared with conventional design because noise was reduced significantly by the acoustically important range from 800 Hz to 1250 Hz structural modification. Predominant peaks still exist at 315 and 1600 Hz third octave bands and govern the overall engine noise. In the present study, in an effort to achieve further noise reduction in this engine, the noise-generating mechanisms at 315 Hz were studied in detail on the running engine as well as using modal analysis and theoretical analysis. It was concluded that the noise peak at 315 Hz was the result of the crankcase resonance induced by the 7th order excitation force caused by the 6th order torsional vibration of the crankshaft. A simple mathematical model was considered to simulate vibration behavior of the crankcase; the effect of mass on the vibration mode was analyzed. Theoretical and modal analyses revealed that with additional inertia mass (representing only 2.5% of total vibrational system of interest) to the crankshaft, the engine noise at 315 Hz can be reduced.

by Kazuomi Ochiai; Mitsuo Nakano

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Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p185-92
Rept. No. SAE-790365; 1979; 2refs

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HS-026 008

ENGINE NOISE REDUCTION BY STRUCTURAL DESIGN USING ADVANCED EXPERIMENTAL AND FINITE ELEMENT METHODS

Structural analyses were performed on an in-line, six-cylinder diesel engine for noise-reduction purposes. (The J-366B vehicle driveby test identified the oil pan and cylinder block wall as producing the highest noise levels; since the oil pan's vibration and resulting noise are controlled by the interface with the block wall, the area most needing improvement is the lower block wall or crankcase skirt.) Both finite-element modeling and experimental structural analysis using digital techniques were performed on the existing design. By applying both of these methods to the same structure, the accuracy of the structural model can be established. After several iterations the results of each method were made to agree quite closely. The finite-element model could then be used for predicting the effect of design changes on the structural response of the block.

by Dean M. Ford; Paul A. Hayes; Stephen K. Smith
Cummins Engine Co., Columbus, Ind.

Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p193-200

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HS-026 009

AN APPROACH TO A QUIET CAR DIESEL ENGINE

A new design for a low-noise diesel engine for passenger cars and small trucks has been developed which is characterized mainly by the vibration isolation between the vibration-excited internal engine structure and the external engine casing. The vibration isolation is effected by one frame-like, flexible element horizontally surrounding the engine. It is attached to the central support and to the engine housing and provides the sealing of the upper side of the oil chamber. Individual elastic elements are attached on the front and back of the engine, whereas the sealing of the oil chamber is provided separately by a highly elastic diaphragm surrounding the engine in the shape of a frame. The upper part of the engine is covered with a thin-walled enclosure made of sheet steel and is ventilated by a fan. Due to the low structural vibrations of the flywheel housing, a transmission gear can be bolted on without an additional enclosure. Elastic elements are used for sealing the crankshaft at the rear wall of the engine housing as well as at the flywheel/gear shaft connection. Preliminary theoretical and experimental investigations of the design concept, tests on a prototype engine using the design (a water-cooled, 2.2-L diesel engine), and the economic viability of the design in different vehicles (cars, small trucks, farm tractors) are discussed.

by Heinz A. Fachbach; Gerhard E. Thien

AVL Prof. List G.m.b.H., Graz, Austria

Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p201-11

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Availability: In HS-025 991

HS-026 010

A SURVEY OF PASSENGER CAR NOISE LEVELS

Results from noise tests on 18 passenger cars (mainly European type) are reported. The sample contains both diesel- and gasoline-engined vehicles, and two cars (a SAAB 99 and Peugeot 504 GLD) are examined in detail over their normal operating range. The diesel cars tested were the Opel 2100 D, Opel 2100 D (T/C), Peugeot 504 GLD, Mercedes 240 D, Oldsmobile Delta 88, and VW Golf LD. The gasoline-powered vehicles were the Plymouth Volare, Rover 3500, Dodge Aspen, Dolomite Sprint, Jaguar XJ6, Saab 99GL, Volvo 244GL, Alpine S, Chevette GL, Cortina 1600, Ford Fiesta, and Renault 4. The effects of vehicle operations are examined and differences between vehicles compared. For equivalent engines, there is shown to be little difference between vehicle noise for diesel and gasoline engines for current legislative test procedures, although idle and low-speed noise levels are increased significantly in the case of the diesel engine. At vehicle speeds above 80 kph in top gear, rolling noise dominates the total vehicle-radiated noise. The test procedure producing the most consistent results is the one where the aim is to assess maximum potential noise levels.

by D. Morrison; B. J. Challen

Ricardo Consulting Engineers

Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p213-22

Rept. No. SAE-790442; 1979; 6refs

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Availability: In HS-025 991

HS-026 011

AN EXPERIMENTAL PASSENGER CAR DIESEL ENGINE

The design and initial evaluation of a novel concept of crankcase design applied to a 2-L, high-speed diesel engine are described. The design offers light weight, low production costs, and low noise without compromising performance. The design concept is based on the principle that if the bearing saddles are simply suspended from the lower deck of the cylinder block with no integral connection through webs or ribs to the sidewalls of the crankcase, then vibration excitation of the crankcase walls can result only from traveling waves from the crankshaft bearing supports and block or bending moments at the lower deck where the crankcase walls are attached. In short, it eliminates the direct force paths from the crankshaft.

by E. C. Grover; R. D. H. Perry

University of Southampton, Inst. of Sound and Vibration Res., Hants., England

Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise Conference Proceedings," Warrendale, Pa., 1979 p223-30

Rept. No. SAE-790443; 1979; 6refs

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Availability: In HS-025 991

HS-026 012

THE EFFECT OF STRUCTURE DESIGN ON HIGH SPEED AUTOMOTIVE DIESEL ENGINE NOISE

The design and testing of two high-speed diesel engine structure modifications to reduce noise are discussed. The modifications

are a five-main-bearing version of a standard three-main-bearing engine and the addition of a sump plate. The results indicate that it is difficult to assess the running-engine vibration and noise characteristics using modal analysis techniques but that this is possible when using the banger test techniques. Noise reductions up to some 4.0 dB(A) to 5.0 dB(A) can be achieved both on the test bed and in the vehicle application. Structural modifications to the engine crankcase and crankshaft were more effective than the additional bolt-on sump plate. The major factor influencing a noise reduction was the elimination of a crankcase mode which gave rise to high noise radiation over the limited frequency range 630 Hz to 1250 Hz.

by D. Anderton; J. Dixon; C. M. P. Chan; S. Andrews
University of Southampton, Inst. of Sound and Vibration Res.,
Hants., England; Search Engineering Ltd., England; British
Leyland Cars, England
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p231-48
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Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979. Research sponsored by Science Res. Council (U.K.).
Availability: In HS-025 991

HS-026 013

SOME ASPECTS CONCERNING NOISE REDUCTION ON DIESEL PASSENGER CARS

The main noise sources of a diesel passenger car (engine and driveline, tailpipe, exhaust system, intake, rolling) and potential for noise reduction are outlined. Primary damping measures for engine noise reduction (e.g. modification of combustion system) and secondary measures (e.g. encapsulation of engine) are described. Complete encapsulation of the engine with the capsule supported by the vehicle (instead of attached to the engine) is considered in more detail. The development of a 2.4-L research diesel passenger car equipped with a vehicle-supported engine capsule is discussed, in particular the design of a new cooling system made necessary by the encapsulation. The maximum possible reduction in external noise levels of the research vehicle (average of 6 dB) and problems related to vehicle-supported encapsulation (e.g. increase in interior noise and vehicle weight, reduced ground clearance, reduced maintenance accessibility) are reported and evaluated.

by Hans-Peter Charzinski; Hermann Hiereth
Daimler-Benz A.G., Germany
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p249-57
Rept. No. SAE-790445; 1979; 9refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979.
Availability: In HS-025 991

HS-026 014

EXPERIMENTAL STUDY OF A HIGH SPEED DIESEL ENGINE BY THE ACOUSTICAL POWER METHOD

The application of the acoustical power method to diesel engine noise analysis in bench tests and analysis of diesel passenger car and van noise is reported. Measurements on a Peugeot XD2 engine showed relatively high noise levels in the medium frequency range between 1000 Hz and 3000 Hz. The following engine components were considered main noise sources, in order of their importance: oil sump, cylinder head, rocker cover, timing cover, front pulley and damper, and cylinder block. An improvement in engine noise was achieved by insulat-

ing the oil sump, timing cover, front pulley with damper, and rocker cover. The effect of adjusting fuel-injection parameters also was studied, but it is felt that altering such parameters to reduce combustion noise is complicated by emission control requirements. Use of the modified engine in a Peugeot delivery van resulted in a reduction of 3 dB(A) in external noise. In the case of the Peugeot 504 passenger car with the same XD2 diesel engine, the noise improvement cannot be expected to be as great because the car engine's noise contribution is 35% vs 50% for the van's engine. Approaches for noise improvement of the diesel passenger car include modification of the internal structure of the engine, turbocharging, combustion and fuel-injection changes, acoustical insulation between the engine and passenger compartment, and shielding of the exhaust system.

by J. M. Kindt; J. Marty
Automobiles Peugeot, France; PSA Peugeot-Citroen, France
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p259-73
Rept. No. SAE-790446; 1979; 6refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979.
Availability: In HS-025 991

HS-026 015

PRACTICAL INVESTIGATION OF NOISE REDUCTION OF A DIESEL PASSENGER CAR

Practical means recently used on Citroen's CX 2500 diesel passenger car in an attempt to produce a vehicle as quiet as its gasoline-engined counterpart (CX 2400) are described. In this effort, the following accomplishments were made: improvement of engine suspension, reduction of intake and exhaust noise, increase in the acoustic insulation of the bulkhead, use of damping materials under the hood, and partial encapsulation of the engine compartment. A level of noise quality (exterior and interior) fairly close to that of gasoline-powered vehicles was obtained; but in spite of the improvements, the diesel noise remains the same at low rpm and especially during idling.

by A. Petitdidier
Automobiles Citroen, France
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p275-83
Rept. No. SAE-790447; 1979
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979.
Availability: In HS-025 991

HS-026 016

CONCEPT FOR A CHASSIS MOUNTED CAPSULE OF ENGINE AND GEARBOX FOR HEAVY TRUCKS

Despite the limitations presented by the small space between the engine and cab in European trucks, an anti-noise capsule to enclose the engine and gearbox which is mounted on the chassis was designed for such diesel trucks. Results of engine bench tests show the surface noise of the engine and gearbox can be reduced by 13 dB(A) to 14 dB(A). The chassis-mounted capsule has advantages with regard to accessibility for maintenance and repair work. It is also possible to redesign the system to attach the upper part of the capsule to the driver's cab; with a tipping cab, these covers are raised automatically. The fan of the water-cooled engine is placed outside the capsule. Despite the difficult airflow conditions created by the capsule front wall, a cooling system was designed whose noise level is the same as that of the enclosed engine.

November 30, 1979

HS-026 020

by Gerhard K. Krisper; Helmut H. Kratochwill
Steyr-Daimler-Puch A.G., Austria
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p285-93
Rept. No. SAE-790449; 1979; 6refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979. Research sponsored in part by Forschungs-forderungs-fond
der Gewerblichen Wirtschaft, Austria.
Availability: In HS-025 991

HS-026 017

RESEARCH PROJECT FOR REDUCING THE NOISE OF TRUCK DIESEL ENGINES

Significant developments in research on noise attenuation of motor vehicles are addressed, starting from the 1930's and culminating in 1974 with the air and water-cooled diesel research engines with close-fitting capsules developed in a project sponsored by FVV (Res. Assoc. for Internal Combustion Engines, Germany). Two basic diesel noise studies are described as representative of individual research carried out by commercial vehicle manufacturers, one dealing with vehicle tests of diesel engines enclosed by body-mounted capsules, the other with tests on close-fitting capsules performed on the test stand. Noise studies of the FVV water-cooled engine with close-fitting capsule are described. The FVV engine and a basic engine without a capsule were each mounted on a truck chassis in order to test capsule effectiveness and to compare measurements of the enclosed engine on the test stand with those of the engine in the vehicle. Discrepancies were found between the two sets of data; but with regard to the measured sound level reduction in the vehicle as well as subjective determinations, the results are regarded as very positive.

by Karl F. Feitzelmayer; W. Schroder
Maschinenfabrik Augsburg Nurnberg A.G., Germany
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p295-303
Rept. No. SAE-790450; 1979; 8refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979.
Availability: In HS-025 991

HS-026 018

NOISE EMISSION OF AIR-COOLED AUTOMOTIVE DIESEL ENGINES AND TRUCKS

The development of two series of air-cooled diesel engines of Klockner-Humboldt-Deutz A.G. (West Germany), the FL 413 series (over 200 hp) and the FL 912/913 series (under 200 hp), is discussed to illustrate the diesel noise improvements attained to date and to report the present development work for further noise reduction. Noise improvements were achieved by modification of fuel-injection timing (FL 413), turbocharging (FL 913), use of damping materials on various engine components, and redesign of cooling fan. Modifications to vehicles equipped with these engines in order to improve noise included minor changes in the air intake and exhaust gas systems, and use of side shields. Noise levels of 82 dB(A) at a distance of 7.5 m during accelerated driveby (and 76 dB(A) at 50 ft) have been achieved. The cost of the improvements amounts to approximately 2% to 3% of the vehicle price.

by H.-A. Kochanowski; W. Kaiser; D. Esche
Klockner-Humboldt-Deutz A.G., Cologne, West Germany
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p305-14
Rept. No. SAE-790451; 1979; 7refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979. Research sponsored in part by Federal Environmental
Agency (West Germany).
Availability: In HS-025 991

HS-026 019

THE TRANSPORT AND ROAD RESEARCH LABORATORY QUIET HEAVY VEHICLE PROJECT

The Transport and Road Res. Lab. (England) Quiet Heavy Vehicle Proj. has succeeded in producing two diesel-engined research tractor units having greatly reduced external and internal noise levels. The first vehicle is based upon the Leyland Buffalo with a gross vehicle weight (GVW) limit of 32 tons and an engine of 212 bhp. The second is a Foden vehicle designed for a maximum GVW of 44 tons and fitted with a Rolls Royce engine of 350 bhp. The project has demonstrated that engine redesign can result in a reduction of noise of 5 dB(A) to 10 dB(A) within reasonable production, performance, and cost restraints. Attention to the exhaust system, cooling package, engine covers, and chassis design has resulted in a 10 dB(A) reduction in cab noise. The Foden/Rolls Royce tractor has been developed to production standards and will enable the costs of production and operation to be evaluated. The final demonstration vehicle has met the target driveby noise level of 80 dB(A).

by A. R. Cawthorne; J. W. Tyler
Transport and Road Res. Lab., Transport Engineering Div.,
Crowthorne, Berks., England
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p315-41
Rept. No. SAE-790452; 1979; 3refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979.
Availability: In HS-025 991

HS-026 020

STATISTICAL APPROACH FOR DIESEL ENGINE NOISE ANALYSIS

Noise measurements were taken of 16 diesel engines of various types (naturally-aspirated and turbocharged; 4-, 5-, 6-, and 8-cylinders; two types of fuel-injection systems) under various operating conditions (e.g. engine speed, engine torque, injection advance, maximum pressure gradient and highest pressure within combustion chamber). The noise and operational structural parameters (e.g. power to weight ratio, cylinder displacement and bore) were analyzed statistically to determine the relative importance of the parameters, to allow identification of noisy engines, and to classify engines into different families with respect to their behavior. Main component analysis (after eliminating the major noise parameter of engine speed) revealed the important influences of load and cylinder capacity on noise level. Formulas were developed for predicting noise for three families of engines. One engine which had a noise level distinctly higher than others was further studied in an effort to reduce its noise radiation to that of the average peak noise level of the other engines. Six remedial solutions were analyzed (three in the field of structural response, two in the field of mechanical excitation, and one in the field of combustion-generated excitation). A noise reduction of 7 dB(A), the target figure, was achieved for the modified engine.

by R. Padoan; M. Jocteur Monrozier
Renault Vehicules Industriels, France
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p343-51
Rept. No. SAE-790454; 1979
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979. Research sponsored mainly by Institut de Recherches des
Transports (France).
Availability: In HS-025 991

HS-026 021

APPLICATION OF ACOUSTIC INTENSITY MEASUREMENT TO ENGINE NOISE EVALUATION

The application to engine noise analysis of a recently-developed cross-spectral method of measuring acoustic intensity is discussed. The effectiveness and practicality of the approach are demonstrated in a series of tests conducted with a naturally-aspirated, two-stroke V-8 diesel engine. A rapid space-time averaging technique for determining the sound power radiated by sections of different engine components is demonstrated, as well as detailed mappings of noise emission by the engine surface. Noise-source ranking of engine components is performed based on intensity measurements made at the engine surface, and the total engine sound power is determined by summing these individual contributions. The sound power determined at the engine surface in this way is compared with estimates of engine sound power based on acoustic intensity measurements made both over a spherical surface and a set of planar surfaces enclosing the engine. Agreement to within 0.1 dB and 0.5 dB, respectively, is obtained. This close agreement is a good indication of the overall accuracy and effectiveness of the acoustic intensity method.

by Y. J. Chung; J. Pope; D. A. Feldmaier
General Motors Res. Labs., Fluid Dynamics Res. Dept.,
Warren, Mich. 48090
Publ: HS-025 991 (SAE-P-80), "Diesel Engine Noise
Conference Proceedings," Warrendale, Pa., 1979 p353-64
Rept. No. SAE-790502; 1979; 21refs
Presented at Congress and Exposition, Detroit, 26 Feb-2 Mar
1979.
Availability: In HS-025 991

HS-026 022

EMISSION AND FUEL ECONOMY MEASUREMENT IMPROVEMENTS

A program was initiated at General Motors Engineering Staff emission facilities in Warren, Mich., to improve the emission and fuel economy measurement accuracy and test cell-to-test cell emissions correlation. The constant volume sampler was improved to resolve the problems of poor mixing, poor temperature control, and abnormal pressure on the vehicle tailpipe which were associated with the original design. Modifications were made to the electric dynamometer to improve its load control, and the calibration procedure was modified to calibrate at current levels closer to those encountered during actual vehicle testing and to more nearly match the loading supplied by the more commonly used mechanical dynamometer. System checks and tests with correlator vehicles were initiated to improve the accuracy of the cell-to-cell bag and modal emissions correlation efforts. Correlation vehicle tests showed that gasoline and diesel testing in the same emission cell had no significant long-term effects on hydrocarbon emission measurements of gasoline vehicles. A list of daily and weekly system checks and a table of calibration ranges are appended.

by W. W. Wiers; G. W. Niepoth; T. D. Hostetter
General Motors Corp.
Rept. No. SAE-790233; 1979; 20p 3refs
Technical Paper Series. Presented at Congress and Exposition,
Detroit, 26 Feb-2 Mar 1979.
Availability: In HS-025 991

HS-026 023

TURBO BASICS [TURBOCHARGING]

The development, operating principles, and applications of turbocharging are discussed. Turbocharging is a method of providing an engine with a pressurized charge of air/fuel mixture to obtain extra power. The aircraft industry was probably responsible for the development of the turbocharging systems in use today. Shortly after World War I, engineers explored the possibility of using exhaust gases to increase power to the airplane engine at altitudes where the atmosphere was less dense. Heat energy, the perfect power source, was utilized by ducting the exhaust gas from the exhaust ports of the internal combustion engine through a small case which housed a turbine wheel, and by hooking the case to a centrifugal pump. The advantages of such a system include the fact that no engine power is required to operate the centrifugal pump, that the power source can be controlled to limit the boost pressure, and that the entire turbine and pump are combined in a very small unit. The control of boost pressure is accomplished by the use of a waste gate, a method of bypassing some of the exhaust gases from the turbine. Late-model passenger car engines are ideally suited to turbocharging. Lower engine compression ratios, necessary for control of emissions, are compatible with boost pressure without water injection or intercoolers (required for engines with higher compression ratios). Overall fuel economy remains about the same as that of a normal engine when running at cruising speeds in top gear.

by Chuck Nerpel
Publ: Motor Trend v31 n3 p90-2, 94-5 (Mar 1979)
1979
Availability: In HS-025 991

HS-026 024

EMERGENCY RESPONSE TO TRANSPORTATION ACCIDENTS--AN OVERVIEW

Federal response to transportation accidents involving radioactive materials is maintained at a high level of readiness through the Interagency Radiological Assistance Plan (IRAP); the only deficiency, likely to be remedied soon, is a lack of definitive protective action guides for the public. On the state level, planning for transportation accidents and response capabilities vary greatly in degree of development, and generally less preparedness exists on the local than on the state level. Timely response and appropriate activities for the protection of the public rely on the knowledge and capabilities of local "first-on-the-scene" organizations, the impetus for developing such proficiency usually coming from the state level. Federal authority under IRAP is limited to assistance to responsible authority; exception is taken only when the IRAP team is first on the scene. A substantial problem exists with the ability of IRAP teams to arrive at an accident scene quickly, especially to remote geographic locations. Obvious public-relations needs include prompt designation of a public information officer who is aware of an accident situation and is kept abreast of developments, is completely candid, and can communicate complex matters clearly. An official position by someone in authority is more important than technical knowledge in allaying public concerns. The updated

transportation regulations regarding radioactive materials seem adequate. Greater protection of the public lies in improving emergency plans and refining response capabilities on state and local levels.

by D. G. Darr
Allied-General Nuclear Services
Rept. No. AGNS-1040-17; 1978; 7p 10refs
Prepared for presentation at 5th International Symposium on Packaging and Transportation of Radioactive Wastes, 8-12 May 1978.
Availability: Corporate author

HS-026 025

THE COSTS AND BENEFITS OF A MID-CONTINENT EXPANSION OF LORAN-C. FINAL REPORT

Loran-C chains currently in operation or approved for construction soon will cover not only the U.S. coastal and Great Lakes waters, but also 63% of the land area and 92% of the population of the contiguous 48 states. The midcontinent expansion of Loran-C, representing the completion of nationwide coverage, could be provided at an initial cost of \$22 million plus \$1.1 million a year in operations and maintenance expenses. These costs would be less than 20% of the existing facilities investment. From a cost/benefit analysis, \$125 million in Loran-C land user benefits is indicated vs. \$52 million in user and Loran-C chain costs during the 1982 to 1990 time period. Significant benefits were found in emergency medical services (\$52M), rural fire suppression (\$22M), police management (\$17M), and highway accident location and traffic records (\$14M). Using a 10% discount rate and benefit estimates restricted to the mid-continent area, other cost-effective applications (benefit-to-cost ratio higher than five) are nuclear materials security, aerial spraying, biomass inventory, and forest fire and wildfire suppression. These estimates were obtained through extensive discussions with seven Federal agencies, many state and local agencies, and industry. The results are conservative and represent only the public benefits of a limited number of potential land applications of Loran-C radionavigation.

by R. L. Wiseman; C. M. Veronda
Transportation Systems Center, Cambridge, Mass. 02142
RS-917/R-9523
Rept. No. DOT-TSC-RSPA-79-3; 1979; 176p 58refs
Rept. for Oct-Dec 1978.
Availability: NTIS

HS-026 026

DRIVING RECORDS OF PERSONS CONVICTED OF DRIVING UNDER THE INFLUENCE OF ALCOHOL

A retrospective evaluation is presented of the driving records of two samples of Tennessee drivers, a random selection from all drivers in the state, and a random selection from drivers receiving at least one DUI (driving under the influence) conviction from 1 Nov 1970 through Dec 1971. The second sample was divided into two subgroups (single and multiple DUI offenders). It was anticipated that differences between the groups might suggest variables to be considered in the design and evaluation of primary and secondary DUI prevention programs. Only a small proportion of the random sample of drivers was convicted of a DUI offense during the 65-month period studied (Nov 1970-Mar 1976). Data on the sample of DUI offenders show that the probability of receiving a second DUI increased markedly relative to the first, and that among multiple DUI offend-

ers there is a high risk that they will continue to receive additional DUI convictions. The average interval between DUI convictions was found to decrease from two years between first and second convictions to 17, 11, and 8 months, respectively, between consecutive subsequent convictions. A study is recommended on the usefulness of identifying potential DUI offenders on the basis of traffic violation and accident records. It may be useful to aim secondary prevention programs at first offenders as well as recidivist drunken drivers, and to include in secondary programs for DUI offenders a course on responsible driving.

by Stephen A. Maisto; Linda Carter Sobell; Paul F. Zelhart; Gerard J. Connors; Terri Cooper
PHS-5-T32-AA07072-02
Publ: Journal of Studies on Alcohol v40 n1 p70-7 (Jan 1979) 1979; 14refs
Sponsored in part by Tennessee Dept. of Mental Health and Mental Retardation.
Availability: See publication

HS-026 027

TRANSPORTATION SYSTEM SAFETY. AN IDEA WHOSE TIME HAS COME

A transportation system safety (TSS) program is described as a detailed set of procedures, analytical tools, and checklists, properly used, that cover every possible aspect of the life cycle or activity cycle of a transportation facility or activity. The key issues are considered to be safety management, human factors in safety, safety analysis data availability, safety measurement, hierarchies and priorities for safety improvement, and analytical techniques for system safety. The project that led to the development of the TSS concept is System Safety: An Interdisciplinary Approach to Transportation Safety, currently in its third year at the Polytechnic Inst. of New York's Dept. of Transportation Planning and Engineering. Among the TSS project's contributions are a literature survey and annotated bibliography of about 500 entries, a report discussing key issues in transportation safety, and a draft TSS methodology. Items completed in the second year include three case-study reports (highway, rail rapid transit, and air transportation), and a new discussion of safety issues in transportation. The third year will see refinement and completion of a TSS methodology applicable to all transportation modes, especially to the rail rapid transit mode, and presentation and dissemination of results of the three-year effort at a symposium on TSS to be held in Washington, D.C. in May 1979. The TSS concept is different from other applications of system safety methodology in that it attempts to apply the system to all modes of transportation, to recognize the major contribution by human factors (especially psychological factors) to transportation accidents, and to codify and systematize all safety-related activities.

by E. J. Cantilli
Publ: Transportation Research News n80 p10-2 (Jan-Feb 1979) 1979
Availability: See publication

HS-026 028

ROAD ACCIDENTS: NEED THEY HAPPEN?

The Transport and Road Res. Lab. (England) has calculated that as many as three-fifths of road casualties could be prevented by improvements in the road environment and vehicle safety (including the use of seat belts), and effective measures to influence road users (e.g. increase risk perception). Different types of accidents show different injury characteristics. Pedestrians are

especially vulnerable, often killed or seriously injured. Leg injuries predominate for pedestrians and motorcyclists, who have more than their share of permanent disabilities. Head injuries, though common in all road-user groups, are most frequent in vehicle occupants and bicyclists; use of seat belts could reduce injuries to the former and wearing of helmets to the latter. In general, multiple injuries are a feature of serious road accidents; compound fractures are common. Multiplicity of injuries that would not individually be life-threatening make death more likely. British accident statistics are encouraging in that although the population at risk has greatly increased, death and injury rates have improved over the years. Safer roads and vehicles, awareness of traffic risks and ways to control them, and better medical treatment are contributing factors.

Publ: British Medical Journal v2 n6146 p1199-1201 (28 Oct 1978)

1978; 15refs

At head of title: A Modern Epidemic.

Availability: See publication

HS-026 029

WHAT CAUSES ROAD ACCIDENTS?

The drinking/driving legislation introduced in the U.K. in 1967 (illegal to drive with a blood alcohol concentration (BAC) over 80 mg/100 ml) had an immediate effect on accident statistics which has subsequently declined; it is estimated that one in five road deaths would be prevented if drivers did not exceed the legal BAC limit. Since the introduction of stricter licensing controls on heavy-goods vehicle drivers since 1967 and limitation of their driving hours and other measures since 1970, accident rates have declined (more rapidly for this class of vehicles than for any other). A decline in pedestrian fatalities started in 1973, ascribed partly to massive publicity campaigns aimed at children and parents. The fuel crisis of 1973-1974, reduced volume of traffic, and lower speed limits (reduced to 50 mph) have contributed to a reduction in U.K. traffic accidents. Accident rates are related to social class and education level, lack of driving experience being one of the main risk factors. Human error is generally agreed to play some part in a large proportion of road accidents. A study by the Transport and Road Res. Lab. (England) of 2130 accidents, in which 1993 people (in 1316 accidents) were injured, 65 fatally, showed that 59% of drivers and 79% of pedestrians were primarily or partly at fault. Of 2211 culpable drivers, 632 were impaired in one or more ways (463 by alcohol, 159 by fatigue, 87 by drugs, 33 by illness, 26 by emotional distress). Human error was the sole apparent cause of 65% of the accidents. An adverse environment contributed to 28% and vehicle defects to 8% of these accidents, but each were sole agents in only 2 1/2% of the accidents. Human faults, particularly errors arising from carelessness, misjudgement, and inexperience, contributed to nearly 95% of the accidents. Impairment by alcohol and other conditions might well be the determining factor in coping with difficulties and hazards while driving. Complex interactions between contributory factors point to the varied scope for countermeasures.

Publ: British Medical Journal v2 n6147 p1272-4 (4 Nov 1978)

1978; 12refs

At head of title: A Modern Epidemic.

Availability: See publication

HS-026 030

CORROSION TESTING OF WHOLE VEHICLES AND VEHICLE BODIES. A NOTE ON CURRENT PRACTICES IN THE U.K. AUTOMOBILE INDUSTRY

Various procedures are briefly described which have been adopted for vehicle corrosion testing by various U.K. auto-makers (unnamed), the Transport and Road Res. Lab. (England), and Ford Motor Co. (U.S.). Although "dynamic" (in that moving vehicles are involved) corrosion tests on automobiles have been carried out by manufacturers, most procedures have lacked certain realistic elements. Although salt solutions can be readily applied to vehicles by running them through shallow troughs, this technique generates conditions considerably different from real-life wet road conditions, and results in a hosing-down effect which prevents any mud buildup. With one exception, there has been no incorporation of a phase where mud cakes are generated, and the single test was not representative of in-service road dirt conditions. Procedures for monitoring the amount of deterioration produced by a given test technique have been developed only to a limited extent. The use of laboratory test facilities can be of considerable value in determining appropriate outdoor test environments. There is a need for a systematic study of in-service corrosion so that deterioration in natural environments can be correlated with track and laboratory test methods. There is also a need for more detailed study of test track procedures in order to achieve an accelerated corrosion cycle without loss of realism.

by J. Nixon

Motor Industry Res. Assoc., Watling St., Nuneaton, Warwick, CV10 0TU, England

Rept. No. MIRA-1976/3; 1976; 5p 4refs

Sponsored by Mechanical Engineering and Machine Tools Res. Requirements Board, Dept. of Industry; and Motor Industry Res. Assoc. See also HS-026 031 and HS-026 032.

Availability: Corporate author

HS-026 031

CORROSION OF MOTOR VEHICLES. PRELIMINARY LABORATORY EXPERIMENTS, DESIGN OF A TEST TRACK, AND MONITORING OF CORROSIVITY IN SERVICE

A realistic corrosion test procedure for motor vehicles is described, including a suitable test facility. Operating conditions in a proposed facility are being investigated in an initial laboratory study to determine optimum levels of such variables as temperature and humidity. From data obtained so far, certain broad trends are identified, and tentative proposals for realistic test schedule conditions offered. Under cyclic humidity conditions, the corrosion rate of unprotected steel sprayed with sodium chloride solutions is dependent on temperature and ratio of wet-to-dry exposure. Temperatures from 35 degrees C to 40 degrees C under conditions of high humidity are most effective in promoting corrosion. Increasing the wet-to-dry time generally results in greater amounts of corrosion, although little difference was apparent at lowest cycling temperature examined (30 degrees C). The corrosivity of the road environment is being monitored in ten regions in England by studying the corrosion of small steel panels fitted to Post Office vehicles operating in localized areas over consecutive two-month (in some cases, one-month) periods. The most important trend observed to date is the considerable increase in road corrosivity when deicing salt is used (an average increase of almost three times in the corrosion rate of exposed steel). The atmospheric corrosion rate varies considerably from area to area, and the areas correlate well

from period to period; the vehicle panel corrosion rate also varies considerably among areas but does not necessarily correlate between periods. It is tentatively concluded that the road environment corrosivity is controlled by the atmospheric corrosivity, with salt acting as an "intensifier". There is evidence that vehicle mileage has a secondary influence on corrosion rate.

by J. Nixon

Motor Industry Res. Assoc., Watling St., Nuneaton, Warwick, CV10 0TU, England
Rept. No. MIRA-1976/4; 1976; 48p 10refs
Sponsored by Mechanical Engineering and Machine Tools Res. Requirements Board, Dept. of Industry; and Motor Industry Res. Assoc. See also HS-206 030 and HS-026 032.
Availability: Corporate author

HS-026 032

CORROSION OF MOTOR VEHICLES. MONITORING THE CORROSIVITY OF THE UK ROAD ENVIRONMENT DURING THE PERIOD SEPTEMBER, 1975, TO OCTOBER, 1976

The corrosivity of the environment was monitored in ten regions throughout England by measuring the rate of weight loss on small steel panels fitted to Post Office vehicles operating in localized areas, and to roofs of buildings. Corrosion rates were determined over consecutive two-month (and in certain cases, one-month) periods from Sep 1975 to Oct 1976 in Tyneside, Leeds-Bradford, Manchester area, East Anglia, Birmingham area, Nuneaton, South Wales, London, Brighton area, and Exeter area. Results show that the overall level of both the road and the atmospheric corrosivity towards exposed steel varied considerably from month to month. When deicing salt was absent, the corrosion rate for vehicle test pieces was only 35% to 40% of the atmospheric corrosion rate, but increased to 85% to 95% in periods of heavy salting, clearly demonstrating the chemical's harmful effect. The regions with the highest corrosion rates are the industrial areas in the north of England, while the influence of marine atmospheres does not appear to be very great. It is evident that the corrosivity of the road environment is controlled by the corrosivity of the atmosphere, with salt acting as an "intensifier". Vehicle mileage is not a primary factor in determining corrosion rate, although it does appear to have a limited influence in salt periods.

by J. Nixon

Motor Industry Res. Assoc., Watling St., Nuneaton, Warwick, CV10 0TU, England
Rept. No. MIRA-1977/2; 1977; 35p 4refs
Sponsored by Mechanical Engineering and Machine Tools Res. Requirements Board, Dept. of Industry; and Motor Industry Res. Assoc. See also HS-026 030 and HS-026 031.
Availability: Corporate author

HS-026 033

CONE BRAKES OFFER NEW DESIGN OPTIONS

Development of cone brakes makes possible improved performance in a unit which saves weight, simplifies manufacture and operation, and offers lower cost. Parts commonality minimizes inventory problems. Dynamometer tests show the suitability of both hydraulic and air modifications. Engagement characteristics for both versions are very smooth; shock loading, fatigue, and component stress are minimal. Speed sensitivity, fade, recovery, and post-fade performance are excellent. The basic configuration is a single (or double) shoe with two pads which bears like a wedge on two planes of a compound cone rotor. Based on dynamometer tests, the cone brake qualified at 0.51

retardation at 550 kPa (80 psi) compared to the Federal Motor Vehicle Safety Standard of 0.41. The application of cone brakes will require additional outboard wheel bearing thrust capacity. All classes of vehicles (including the new generation of front-drive passenger vehicles and Class 5, 6, 7, and 8 trucks) may be able to use the concept. Preliminary cost comparisons indicate that cone brakes can compete with the 16 1/2 x 7 internal-expanding shoe-type air brake (30% savings) and the 15 x 4 internal-expanding shoe-type hydraulic brake.

Publ: Automotive Engineering v87 n4 p26-8 (Apr 1979)
1979

Based on SAE-790465, "Testing the Cone Brake Design," by Morris E. Johnson.
Availability: See publication

HS-026 034

QUICK-START SYSTEM USES NEW GLOW PLUGS [DIESEL ENGINES]

General Motors has developed a quick-start system for its passenger-car diesel engines which reduces glow plug heat-up time from 60 sec to 6.5 sec. Even with peak power battery drain twice as high as that of the system it replaces, total energy drained from the battery is reduced. Since the power applied to heat the glow plug is approximately five times the power required to sustain heat losses, a control system had to be developed to maintain the required operating temperature. The new control is based on the principle that if a thermal model of the glow plug is built in the form of a bimetallic element, then the control of the bimetallic element through a heater and contact set results in the identical control function required of the glow plug. The bimetallic element and its heater are a surrogate glow plug scaled down to an ideal operating temperature for bimetals. Such an arrangement yields a correct glow plug/bimetal temperature relationship for all values of supply voltage and all arbitrary switching functions of the ignition switch, since both bimetal heater and glow plug are wired in parallel and both are heaters which dissipate power as the squared function of applied voltage. The bimetal element mounted on the engine "senses" engine temperature, and the glow plug temperature modulates inversely with that temperature without an additional external temperature sensor. A hysteresis built into the bimetal switching action results in about a 130 degrees C glow plug temperature excursion at a six-second cycling period (giving acceptable component life while maintaining reasonable excursions). A back-up mode to the bimetallic element is provided, signalled by a dashboard light.

Publ: Automotive Engineering v87 n4 p31-3 (Apr 1979)
1979

Based on SAE-790208, "Design of a Fast Start Glow Plug Control System for Diesel Engines," by Arthur R. Sundeen.
Availability: See publication

HS-026 035

HIGH-ENERGY TUBULAR BATTERY DEVELOPED IN U.K. [UNITED KINGDOM]

A high-energy (34 Wh/kg) lead-acid battery developed by Chloride Technical Ltd. provides an 1800-kg payload electric delivery van with a range of 80 km to 90 km, a 40% improvement over the 55 km to 65 km range of conventional traction batteries. A four-year battery life is also expected, due to the reinforcing features of the tubular design adopted for the positive electrode. The tubular positive plate consists of a series of vertical lead spines cast from a horizontal shoulder section con-

taining the terminal lug. The spines become the fingers of a fabric gauntlet formed in a series of parallel tubes, and the annulus between the gauntlet and the spine is filled with lead oxide. The bottom end is sealed with an enclosing bar. The gauntlet acts as a girdle, pushing the active material firmly against the spine and assuring a durable electrical contact. The weight of the battery packaging was reduced by using lightweight materials for cell containers, battery trays, and electrical connectors. Robust, nonporous tray coatings were developed to protect the inside of the trays from acid corrosion and the outside from salt spray; the internal coating was also designed to provide insulation to reduce ground leakage currents. An automatic topping-up system for watering the cells was developed which doubles as a gas collection and remote safe-venting system. A range of fully automatic battery chargers was developed with recharge time (full charge) from four to 16 hours. The first nine months of operation of the first production batch of Silent Karrier delivery vans has reinforced confidence in the basic power-pack design.

Publ: Automotive Engineering v87 n4 p34-7 (Apr 1979)
1979

Based on SAE-790162, "A High Energy Tubular Battery for a 1800 kg Payload Electric Delivery Van," by Michael L. Whitehead.

Availability: See publication

HS-026 036

FIBER-REINFORCED AUTOMOTIVE WHEELS: PROMISES AND CHALLENGES

Fiber-reinforced plastic (FRP) wheels offer the advantages of being lighter, more uniform, more easily styled, and more corrosion resistant than metal wheels. Challenges to their successful development involve wheel design (analysis of both stress distribution and material flow required for optimum fiber orientation), nondestructive evaluation of fiber orientation and concentration within the wheel, new SAE (Society of Automotive Engineers) specifications and testing (radial fatigue test, rotary fatigue test, and guillotine impact test), and field testing to establish validity of proposed tests. Currently, compression molding seems to be the most suitable production process for reinforced plastic automotive wheels. This process has been simplified by the development of sheet molding compounds which can be cut to desired shapes and sizes and placed in a mold, bypassing the preforming stage.

Publ: Automotive Engineering v87 n4 p38-42 (Apr 1979)
1979; 1ref

Based on SAE-790432, "Fiber-Reinforced Automotive Wheels: Promises and Challenges," by R. A. Ridha.

Availability: See publication

HS-026 037

HALOGEN HEADLAMPS CAN DOUBLE LIGHT OUTPUT

Halogen headlamps are now allowed in the U.S. because the National Hwy. Traffic Safety Administration increased high-beam light output to a maximum of 150,000 candela. This doubling of standard-lamp candlepower will be achieved with no increase in power consumption. Halogen-cycle phenomena allow manufacture of lamps which are in a smaller package of higher wattage than conventional vacuum or gas-filled incandescent lamps of comparable design. Without the halogen additives to the gas fill, a small-volume bulb would blacken rapidly, rendering it impractical. The new halogen headlamps use inner

bulbs and lenses with different optics to put more light down the center of the road for increased visibility when driving with the high-beam system. The headlamps are required to be of the standard sealed construction, to provide for mechanical aiming and to be designed to Society of Automotive Engineers dimensions and photometric specifications. Standardization of the headlamps to four configurations provides motorists with widely-available replacements, including a standard headlamp if a replacement halogen headlamp is not available.

Publ: Automotive Engineering v87 n4 p49-53 (Apr 1979)
1979

Based on SAE-790200, "Halogen Sealed Beam Headlights," by Ralph A. Ehrhardt.

Availability: See publication

HS-026 038

AIRBAG DEPLOYMENT TAILORED TO IMPACT SEVERITY

Daimler-Benz A.G. (Germany) engineers have developed a passive restraint system incorporating a passenger-side air bag with dual-level deployment capability which depends upon crash severity. The impact sensor is designed to detect low and high impact severity levels, and to trigger one or both of two gas generators which inflate the air bag. In a low-level impact only one generator is actuated, and the second generator operates only in case of a higher-level impact, together with, or after, the driver-side air bag. This kind of incremental deployment is advantageous in low-speed impacts and in the cases of the standing child and out-of-position passenger, and reduces deployment noise levels. In addition to the upper torso air bag protection the Mercedes-Benz system incorporates knee bolsters to prevent submarining and to limit impact loads on the lower extremities. Daimler-Benz engineers recommend use of the passive restraint system in combination with a three-point lap/shoulder safety belt system. Selection of the most favorable belt elongation for a combined passive/active system is believed impossible due to U.S. and European seat belt regulations. Amendment of the regulations to permit high-elongation webbing or force-limiting devices is deemed necessary to allow appropriate tuning of all components of the combined restraint system.

Publ: Automotive Engineering v87 n4 p54-7 (Apr 1979)
1979

Based on SAE-790321, "Advanced Restraint System Concepts," by W. Reidelbach and H. Scholz.

Availability: See publication

HS-026 039

COMPUTERS OPTIMIZE POWERTRAIN MATCHING FOR BEST ECONOMY

Mathematical modeling techniques provide rational approaches for identifying fuel economy opportunities of powertrain matching, permitting evaluation and optimization of hardware alternatives before building and testing prototype systems. The vehicle fuel economy and performance simulation model currently used at Ford Motor Co. consists of two separate programs using common data base. The fuel economy simulation program calculates the second-by-second power required for a given driving cycle. Calculations, proceeding from rear tires to engine, include rolling resistance, drivetrain efficiencies, transmission shift logic, and accessory losses. Output summaries of fuel usage, time spent in each transmission gear, engine operation, and accessory power consumption are available for detailed analysis. The performance program computes wide-open- and part-thro-

the vehicle performance (0 mph to 60 mph time, elapsed time for a quarter mile, and maximum acceleration and speed). Detailed second-by-second summaries coupled with a computer graphics program are used to assess vehicle gradeability, part-throttle response, and optimum transmission shift schedule logic. The computer simulation technique is an extremely valuable tool for use in powertrain matching tasks such as engine sizing, torque converter selection, transmission gear ratio selection, transmission shift scheduling, and rear axle selection. Use of computer simulation of the vehicle/powertrain system allows evaluation of fuel economy, performance, and emissions tradeoffs.

Publ: Automotive Engineering v87 n4 p60-4 (Apr 1979)
1979

Based on SAE-790045, "Powertrain Matching for Better Fuel Economy," by Lawrence T. Wong, and William J. Clemens.
Availability: See publication

HS-026 040

IH [INTERNATIONAL HARVESTER] PLUNGES INTO ALUMINUM WELDING

In 1976, International Harvester (IH) started to produce its all-aluminum Transtar cab instead of buying it from an independent manufacturer, and turned to gas metal arc welding as a fast and reliable aluminum welding process. This process, as well as Hobart's Linear II aluminum wire feeding system, was used at IH's Springfield, Ohio, truck body plant. To help maintain consistency in welding parameters, IH requested Hobart Brothers Co. (Troy, Mich.) to provide dual-schedule capability for welders (one schedule for thinner-gauge aluminum, the other for heavier stock). There are six welders to a station, each with a specific function. The cabs remain an average of 5.5 min at each area before they move to the next assembly section. Quality controllers inspect the welds for holes and frequently conduct welding strength tests. All Transtar models (bumper-to-back-of-cab lengths of 59 in, 74 in, and 88 in) are made on the same assembly line. Since fixture changes can be made in seconds at each welding station, the line loses only about half a unit of production when changing cab lengths. An hour and a half after it started as a floor pan, the Transtar has been assembled with over 200 in of welds. The cab then is fitted with doors, primed, and shipped to IH's Fort Wayne, Ind., plant for further assembly and additional quality inspection.

by Michael K. McCann

Publ: Truck and Off-Highway Industries v1 n2 p39-40 (Mar-Apr 1979)
1979

Availability: See publication

HS-026 041

SECRET CAR WARRANTIES--FREE REPAIRS THE AUTOMAKERS DON'T PUBLICIZE

About 300 secret warranties (or policy adjustments or goodwill service) to cover factory defects are estimated to be offered by General Motors, Ford, Chrysler, and American Motors, and virtually all auto importers. The automakers spend a great deal of money on secret warranty programs to enhance their reputations for quality and reliability, but the consumer must be persistent in order to obtain coverage under such programs. Two of the largest secret-warranty cases costing the auto companies millions of dollars were the Ford rust warranties of the late 1960's and early 1970's, and the Vega warranties of the early 1970's (engine and body). Obstacles to benefiting from secret warranties include dealers who do not know about the coverage

or who do not like warranty work, car owners who are not aware of secret warranties, and "adjustment" instructions authorizing warranty work which are hidden in service bulletins. Judgments made by factory zone managers about warranty coverage can be decided by the condition of the car. A well-kept car can bring good results and vice versa, and luxury-car owners and long-time customers tend to receive preferential treatment. Experienced warranty people say that car companies are most concerned about the mechanical parts of the car, especially the powertrain, and are more likely to fix these free. Paint, body parts, interior trim items, and decorative veneer are less likely to be replaced free out of warranty. It is not unusual to get an adjustment for a defective transmission, rear axle, or engine block long after the 12-mo limit, these parts being the bedrock of an automaker's reputation. Until recently the only recourse for dissatisfied car owners denied post-warranty coverage was through court action, but auto companies are now beginning to experiment with binding arbitration or a "court of appeals" to settle complaints that have been turned down. Many attorneys and consumers see notification of car owners about secret warranties of utmost importance, although the enormous cost of such notification worries automobile manufacturers.

by Jim Dunne

Publ: Popular Science v214 n5 p56, 58-60, 168 (May 1979)
1979

Availability: See publication

HS-029 929

STATEMENT TO THE SENATE COMMERCE, SCIENCE AND TRANSPORTATION COMMITTEE ON GOVERNMENT/INDUSTRY ROLES IN FUTURE AUTOMOTIVE DEVELOPMENT, WASHINGTON, D.C., MARCH 23, 1979

General Motors Corp. states that improving fuel efficiency of its automobiles remains a top priority, but that the current fuel economy standards are not cost-effective. The present front-loaded standards, which increase 2 mpg in 1981, 1982, and 1983 will add an estimated \$590 in consumer cost to the average GM car in 1985, when the standard reaches 27.5 mpg. GM has recommended consideration of two slightly less stringent alternative schedules. One of these would increase the standards by 1.5 mpg annually to 27.5 mpg in 1985 (reduction of consumer cost to \$450); the other would increase by 1 mpg per year through 1984, 2 mpg for 1985, and 1/2 mpg per year through 1988, when the standard would reach 27.5 mpg (consumer cost of \$285). The current fuel economy standards, coupled with other Federal standards for safety and emissions, will be largely responsible for enormous annual capital investments by GM. GM believes that risking the financial viability of the auto industry to save a relatively small amount of fuel is not a wise investment on the behalf of the public. Looking to the years beyond 1985, and into the 1990's, GM remains hopeful that some of its present research will result in more fuel-efficient vehicles or ones that operate on domestically-produced fuels. GM believes that the roles of the government and the industry are distinctly different but closely related in research toward safer, more fuel-efficient cars. The company believes that the government should take the lead in reviewing all standards and their timetables to be certain they are cost-effective and do not impose unnecessary cost burdens; in performing necessary research on the health effects of vehicle emissions; in conducting research on ways to reduce the cost of producing alternate fuels; in continually reexamining and adjusting trade policies; and in conducting fundamental research, such as on ceramics for engines and on the combustion process itself. Appended are GM papers of 15 Feb 1979 (submitted to the National Hwy.

Traffic Safety Administration) on current and alternative fuel economy schedules, and of 27 Feb 1979 (submitted to the Dept. of Transportation) on future vehicle powerplants, by C. A. Amann.

by David S. Potter
General Motors Corp.
1979; 48p
Availability: Corporate author

HS-803 369

AN ANALYSIS OF INDUSTRY RESPONSES TO FEDERAL REGULATIONS IN SAFETY REQUIREMENTS FOR NEW AUTOMOBILES. FINAL REPORT

Findings are presented of an initial study of the response of the automobile industry to the promulgation of Federal automotive standards. The study examined three Federal Motor Vehicle Safety Standards (FMVSS's) as evaluative cases: FMVSS 203, Steering Column/Impact; FMVSS 212, Windshield Mounting; and FMVSS 215, Exterior Protection. Industry responses to the standards, the effects of the standards on industry, and the role of government in vehicle safety standard development are discussed. Appended are general comments by Ford Motor Co. on proposed initial FMVSS's, and the three standards examined. It is concluded that societal attitudes and economic conditions are most important in the industry's response to proposed rulemaking. In the three standards under study, the automobile industry was concerned mainly with the problems and increased costs that would result from not allowing sufficient time to permit incorporation of the necessary design changes into the normal production process. There is industry concern over the lack of precision in defining standard requirements and test procedures, believed to be the result of insufficient research and development prior to rulemaking. Industry in general is favorably inclined toward the existing standards, with only two (FMVSS 211, Nuts and Discs, and FMVSS 112, Headlamp Concealment) being considered unnecessary. Governmental research and development has had impact on manufacturer technology implementation. The key to acceptance of any safety standard is clearly at the highest levels of a company's management, with the engineering staff having the strongest role in the decision process among the functional activities. The following areas require further investigation to provide guidance in policy formulation relative to technology implementation for vehicle safety standards: determining necessary lead time requirements; investigating current benefit/cost relationships and relationships between company size and cost of implementing a standard; coordinating research between government and industry; and developing a long-term implementation plan.

by Howard M. Bunch; Michael Kubacki
University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich. 48109
TS-13084
Rept. No. DOT-TSC-NHTSA-78-26; PB-288 546; 1978; 111p
refs
Rept. for Nov 1976-Apr 1977.
Availability: NTIS

HS-803 595

DRIVER SCREENING SIMULATOR EVALUATION PROGRAM. FINAL REPORT

A Driver Screening Simulator (DSS) had been developed by the Oklahoma Dept. of Public Safety (DPS), to duplicate the

current DPS road test for the issuance of driver licenses. The projected use of the DSS was to determine readiness for the road test, rather than to replace it. Primary purpose of the evaluation was to perform a comparative analysis between the two tests with regular state personnel conducting both tests. All data gathered (printouts and copies of applications, written tests, vision tests, road tests and attitude tests) were utilized for analysis; and after appropriate processing and analysis, are included, with all original records obtained from this study. In spite of machine difficulties and incomplete design, the evaluation showed that driver license applicants can approximate the results of a given road test with that of DSS. Design deficiencies are correctable and would be cost effective. Applicant response was generally favorable. Further evaluation is proceeding with a second generation DSS type unit incorporating recommended changes; it is further recommended that a programmable DSS be developed as part of a program to identify the potential problem driver.

by Lewis Barker; Jerry Polson; Phil DuPont
Southeastern Oklahoma State Univ., Grants and Contracts
Office, P.O. Box 2675, Station A, Durant, Okla. 74701
DOT-HS-6-01490
1978; 138p
Rept. for 1 Oct 1976-30 Sep 1977.
Availability: NTIS

HS-803 605

THE NATIONAL ACCIDENT SAMPLING SYSTEM, A STATUS REPORT. VOL. 1: OBJECTIVES OF THE NATIONAL ACCIDENT SAMPLING SYSTEM

A National Accident Sampling System (NASS) has been established to help provide a valid representation of the national accident situation. Implementation of the system has begun with the establishment of the first ten randomly selected accident data collection sites; the complete system will not be operational before 1982. The objectives and use of NASS are to estimate and disseminate annual national totals and rates of accidents, accident causes, and consequences, at a level of detail not currently available; evaluate existing countermeasures, Motor Vehicle Safety Standards and Highway Safety Program Standards; provide data during the field test or demonstration phase of proposed standards and countermeasures to assist in the evaluation of the likely accident and injury reducing benefit; and provide a current and detailed accident and injury causation data base suitable for establishing priorities for, and assisting in, the design of future countermeasures. Close cooperation and planning are necessary between analysts who require highway safety field data and those who are responsible for designing, implementing and operating the system. The system does not stand alone; other data sources should be considered when utilizing NASS, particularly the Fatal Accident Reporting System, a census of fatal traffic accidents, and the National Exposure Data System, which will collect information on the population at risk.

National Hwy. Traffic Safety Administration, National Center for Statistics and Analysis, Washington, D.C. 20590
1978; 31p 8refs
Vols. 2 and 3 are HS-804 028--HS 804 029; Vol. 4 is HS-804 852. See also HS-804 027 (Apr 1979).
Availability: Corporate author

HS-803 808

**AUTOMOTIVE FUEL ECONOMY AND EMISSIONS
EXPERIMENTAL DATA. FINAL REPORT**

Experimental tests were conducted on engines and vehicles to generate data for an assessment of the relationship between automobile fuel economy and emission control systems. Detailed investigations were made on cold-start emission devices, exhaust gas recirculation (EGR) systems, and air injection reactor (AIR) systems. Based on the results of engine tests, an alternative emission control system and modified control strategy were implemented and tested in the vehicle. The modified vehicle used a selected EGR/spark advance control strategy, a stock AIR strategy, a stock EGR delay time, a parallel-path exhaust system, and a cold-start catalyst unit and standard catalyst unit modified with an electrically-heated catalyst element. With the same fuel economy and NOx (nitrogen oxides) emissions as the stock vehicle (1975 Plymouth Valiant with six-cylinder engine), the modified vehicle reduced hydrocarbon and carbon monoxide emissions by about 20%. By removing the NOx emissions constraint, the modified vehicle demonstrated about 12% better fuel economy. Appended are baseline vehicle data, calibrations for EGR valve and AIR pump, baseline engine data, EGR/spark advance sensitivity data, EGR/spark advance strategies, and AIR sensitivity data.

by Mack W. Dowdy; Ronald L. Baisley
California Inst. of Tech., Jet Propulsion Lab., 4800 Oak Grove
Drive, Pasadena, Calif. 91103
RA-75-41

Rept. No. DOT-TSC-NHTSA-79-15; JPL-78-21; 1979; 217p
49refs

Rept. for Jun 1975-Dec 1976.

Availability: NTIS

HS-803 813

**DRIVERS' DUTIES AT RAILROAD GRADE
CROSSINGS**

State motor vehicle and traffic laws applicable to railroad grade crossings are reviewed, limited to provisions appearing in state vehicle codes and excluding laws appearing in state codes relating to highways or railroads. Every attempt has been made to reflect laws that were in effect on 1 Jan 78. The following aspects of the various state laws, as well as relevant provisions of the Uniform Vehicle Code, are treated separately: safe speed required at grade crossings, passing restrictions at grade crossings, stop when train is near or when signalized to stop, stopping for stop signs, stops by school buses and vehicles transporting hazardous substances, low and slow vehicle at grade crossings, entry onto crossing in heavy traffic, stopping on railroad tracks, parking near grade crossings, pedestrian on railroad grade crossing, damaging or interfering with railroad signs or signals, railroad definitions, blocking of crossings by trains, and miscellaneous provisions.

by Edward F. Kearney
National Com. on Uniform Traffic Laws and Ordinances
DOT-HS-5-01121

Publ: Traffic Laws Commentary v8 n1 (Jan 1979)

1979; 86p refs

Availability: GPO, stock no. 050-003-00345-0

HS-803 815

**POINT SYSTEM COMPARISON [TRAFFIC
VIOLATIONS]**

A summary is presented of the point system laws and regulations enacted by the various states as of 31 Dec 1977, as compared with the latest edition of the Uniform Vehicle Code (UVC). Forty jurisdictions have laws or regulations establishing a point system to aid in weighing traffic violations. As reports of convictions are received from the courts, a demerit value is charged against an individual's driving record. When a driver's record shows a specified point total, his driving privilege may be suspended. The provision in the UVC concerning establishment of a point system is presented, and the state laws are described in terms of statutory authority, suspension point total and period of suspension, assessment of points (speeding, all other moving violations, multiple-charge convictions, out-of-state convictions, and nonassessable violations), warnings prior to suspension, point reduction and/or credit points, and hearing requirements. The approach used to obtaining information on administrative regulations concerning point systems and response received from the states are described in an appendix. It is recommended that those states without a point system establish one, and that all states strive for uniformity of their provisions (using the UVC framework). If details for the point system are to be left to administrative regulation, it is deemed necessary that the responsible agency maintain such regulations in appropriate form.

by Brenda B. Williams
National Com. on Uniform Traffic Laws and Ordinances
DOT-HS-5-01121

Publ: Traffic Laws Commentary v8 n2 (Feb 1979)
1979; 54p refs

Availability: GPO, stock no. 050-003-00346-8

HS-803 818

**STATISTICAL ANALYSIS OF CRASH CONDITIONS
AND THEIR RELATIONSHIP TO INJURIES. FINAL
REPORT**

In order to investigate the relationship of crash conditions to injury, statistical models were developed relating injury probabilities in generalized body regions to crash conditions. The data available for use was the Restraint System Evaluation Program file which contains a sample of front seat occupants of 1973 through 1975 model year automobiles in 1974-1975 towaway accidents. The file had been upgraded with the inclusion of calculated crash severity parameters such as barrier equivalent velocity and various crush measures. During the analysis a number of additional crash severity parameters were formulated. A large number of statistical techniques were utilized during the course of the work including AID, cluster analysis, discriminant analysis, categorical analysis, and logistic analysis. The analyses primarily addressed unrestrained unejected occupants in frontal and side impacts. Restrained occupants were considered to a lesser extent. The resulting models provide an injury probability description whose most significant parameter is crash severity but which also includes occupant characteristics and other parameters.

by Lawrence A. Klimko; Keith Friedman
University of Wisconsin, Statistical Lab., Madison, Wis.; Kinetic
Res., Inc., 6613 Seybold Rd., Madison, Wis.
DOT-HS-7-01559

1978; 170p 12refs

Rept. for Jan 1977-May 1978.

Availability: NTIS

HS-803 827

HSL 79-11

HS-803 827

**TRAFFIC SAFETY DEMONSTRATION PROGRAM
MODELING SYSTEM. VOL. 1: TECHNICAL
SUMMARY. FINAL REPORT**

The Traffic Safety Demonstration Program Modeling System (DEMON) is an interactive computer model for use in the analysis of individual National Hwy. Traffic Safety Administration (NHTSA) demonstration projects. Ongoing projects are currently being analyzed using this system, and new or alternative concepts may also be modeled. Vol. 1 is a technical summary of the modeling system, an approach based on system flow modeling concepts that has been used successfully by NHTSA to measure the operating characteristics of demonstration projects prior to their implementation and to estimate their impact. An application of the method is demonstrated and a general introduction to the system provided.

by N. A. David; S. I. Gass; R. H. Cronin; R. E. Denny
SRI International, 333 Ravenswood Ave., Menlo Park, Calif.
94025

DOT-HS-6-01401

Rept. No. SRI-5520; 1977; 40p

Rept. for 14 Jun 1976-30 Jun 1977. Vol. 2, System Manual, is HS-803 828; Vol. 3, Citizens Band Radio Model, is HS-803 829; Vol. 4 (HS-803 830) contains appendices. Cover date is Feb 1979.

Availability: NTIS

HS-803 828

**TRAFFIC SAFETY DEMONSTRATION PROGRAM
MODELING SYSTEM. VOL. 2: SYSTEM MANUAL.
FINAL REPORT**

The Traffic Safety Demonstration Program Modeling System (DEMON) is an interactive computer model for use in the analysis of individual National Hwy. Traffic Safety Administration demonstration projects. Ongoing projects are currently being analyzed using this system, and new or alternative concepts may also be modeled. The DEMON system access, and the mathematical assumptions made are documented and the operating system is described. Pre-set or newly derived data files are called by DEMON to study new options of varying the target groups being studied, increasing or decreasing costs and workload associated with sequences of countermeasures. Recidivism estimates are made so that statistical analysis of proposed project impact may be conducted. DEMON computes sample sizes obtained and, alternatively, those required to assess impact within desired confidence bounds. The system is highly interactive and was designed for a noncomputer-oriented user. A reader wishing to determine whether the model would be applicable to a problem should read Vol. 1; if interested in mathematical assumptions, he should read Section 2 of this volume. If the user has interest in using the model without great attention to technical details, reading Vol. 1 is suggested, as well as Section 3 of this volume.

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94025

DOT-HS-6-01401

Rept. No. SRI-5520; 1977; 111p 1ref

Rept. for 14 Jun 1976-30 Jun 1977. Vol. 1, Technical Summary, is HS-803 827; Vol. 3, Citizens Band Radio Model, is HS-803 829; Vol. 4 (HS-803 830) contains appendices. Cover date is Feb 1979.

Availability: NTIS

HS-803 829

**TRAFFIC SAFETY DEMONSTRATION PROGRAM
MODELING SYSTEM. VOL. 3: CITIZENS BAND
RADIO MODEL. FINAL REPORT**

The Traffic Safety Demonstration Program Modeling System (DEMON) is an interactive computer model for use in the analysis of individual National Hwy. Traffic Safety Administration demonstration projects. Ongoing projects are currently being analyzed using this system, and new or alternative concepts may also be modeled. Volume 3 documents a specialized model of the use of citizens band (CB) radio by highway patrol, describing the CB radio model which was designed to measure the role of CB units in a Highway Patrol emergency response system. A mathematical simulation, the model is used to describe the geography, dynamics, and emergency response situations (e.g., accidents, road hazards and speeders) for a given set of assumed conditions. The model can measure various changes in the detection, notification and response times of a system, evaluating the activities on the highway and comparing the emergency response times for the Highway Patrol with and without a CB communication system, i.e., under experimental and control situations. Details of the mathematical aspects of the modeling are given, with instructions for users and some examples of output.

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94025

DOT-HS-6-01401

Rept. No. SRI-5520; 1977; 90p 2refs

Rept. for 14 Jun 1976-30 Jun 1977. Vol. 1, Technical Summary, is HS-803 827; Vol. 2, System Manual, is HS-803 828; Vol. 4 (HS-803 830) contains appendices. Cover date is Feb 1979.

Availability: NTIS

HS-803 830

**TRAFFIC SAFETY DEMONSTRATION PROGRAM
MODELING SYSTEM. VOL. 4: APPENDICES. FINAL
REPORT**

The Traffic Safety Demonstration Program Modeling System (DEMON) is an interactive computer model for use in the analysis of individual National Hwy. Traffic Safety Administration demonstration projects. Ongoing projects are currently being analyzed using this system, and new or alternative concepts may also be modeled. Appendices are given in Vol. 4. Appendices A-F give a description, flow definition and data file for six projects: Probation, Young Problem Drivers, Driver Licensing, Motorcycle Licensing, Offender Treatment, and Secondary Schools. Appendix G provides descriptions of the program files, subroutines, and variables, as well as a program flowchart and a complete program listing.

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94025

DOT-HS-6-01401

Rept. No. SRI-5520; 1977; 246p

Rept. for 14 Jun 1976-30 Jun 1977. Vol., Technical Summary is HS-803 827; Vol. 2, System Manual, is HS-803 828; Vol. 3, Citizens Band Radio Model, is HS-803 829. Cover date is Feb 1979.

Availability: NTIS

HS-803 859

**VALIDATION AND APPLICATION OF THE
WRECKER NONLINEAR FINITE ELEMENT
PROGRAM IN ANALYZING VEHICLE SIDE
STRUCTURES. VOL. 1: SUMMARY REPORT. FINAL
REPORT**

by Preston G. Smith; Albert S. Kuo; George D. Gunn
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Div., 5408A Port Royal Rd., Springfield, Va. 22151
DOT-HS-7-01628
Rept. No. 1182F-I; 1978; 31p 10refs
Rept. for 1 Jun 1977-31 Dec 1978. For abstract, see HS-803 860.
Availability: NTIS

HS-803 860

**VALIDATION AND APPLICATION OF THE
WRECKER NONLINEAR FINITE ELEMENT
PROGRAM IN ANALYZING VEHICLE SIDE
STRUCTURES. VOL. 2: TECHNICAL REPORT**

WRECKER, a new computer program developed to calculate the large deformation response of car bodies during impact, has the ability to accurately handle the very large displacements and rotations involved, and to effectively model the material's properties and the types of irregular shapes found in cars. The project is designed to determine the program's strengths and weaknesses in analyzing actual automotive structure. A finite element model was developed of a Volkswagen Rabbit side structure under Federal compliance test (FMVSS 214) quasi-static loading; the program validation procedure was specifically designed to be objective and quantitative. The following capabilities were added as required to strengthen the program: a redimensionable version of the code; nodal contact capability; a three-node beam element; various input and output improvements; and three preprocessors to aid in preparing the input data. Seven errors were found in the code and corrected. WRECKER still has some shortcomings that limit its ability to perform large deformation plastic side structure analysis. These weaknesses include: a calculation instability under in-plane tensile loads, some difficulties in plasticity modeling, nonpositive definite stiffness matrix messages, lack of capability to model failure mechanisms or door flange mechanics, uncertainties concerning rotational constraint of the plate element, and other lesser problems. Recommendations are made for correcting most of these shortcomings.

by Preston G. Smith; Albert S. Kuo; George D. Gunn
ENSCO, Inc., Transportation and Instrumentation Sciences
Div., 5408A Port Royal Rd., Springfield, Va. 22151
DOT-HS-7-01628
Rept. No. 1182F-II; 1978; 237p 17refs
Rept. for 1 Jun 1977-31 Dec 1978. Vol. 1, Summary Rept. is HS-803 859.
Availability: NTIS

HS-803 861

**DEVELOPMENT OF A LOW COST ANTI-LOCK
BRAKE SYSTEM FOR SMALL MOTORCYCLES.
FINAL REPORT**

As a continuation of earlier work reported in Towards a Low Cost, Highly Reliable Anti-Lock Brake System For Small Motorcycles (DOT-HS-802 288), an analysis, design and test of a toroidal jerk (rate of change of angular acceleration) sensor are presented. The control system proposed by these two studies

utilizes jerk as the feedback signature of impending wheel lock. Results show that the toroidal jerk sensor can be used as the critical sensor in the system while a model exists which can be used to design the device to match given requirements. Brake pressure control techniques are discussed, including pressure bleed effects, a brake pressure replenisher, fluidic power brake unit and jet pipe brake pressure controller. Systems analysis includes sensors, pressure control techniques, and power supplies. Recommendations are made regarding a suitable working fluid for the particular application (hydraulic or pneumatic), while a typical fluidic gain circuit computer model is appended.

by Stephen M. Tenney; John M. Goto
Harry Diamond Labs., 2800 Powder Mill Rd., Adelphi, Md. 20783
DOT-HS-7-D1524
1978; 49p 2refs
Rept. for 19 Jan 1977-Jan 1978. See also HS-802 288.
Availability: NTIS

HS-803 866

**DISTRICT OF COLUMBIA TRUCK AND BUS
SAFETY DEMONSTRATION PROJECT. FINAL
REPORT**

The validity and effectiveness are demonstrated of the Federal Motor Vehicle Safety Standards (FMVSS) and Regulations, Vehicle in Use (VIU) Inspection Standards, Part 570, Subpart B, in discovering safety-critical outages during periodic inspection of vehicles with Gross Vehicle Weight Rating (GVWR) of more than 10,000 pounds. An opportunity was provided for evaluating some commercially available heavy duty automotive inspection equipment, particularly FMVSS 121 System anti-skid brake test equipment. Data were obtained and procedures developed for testing 121 Systems in an inspection lane environment. Conclusions are that a highly skilled 3-person inspection team can thoroughly inspect a truck or bus in about 18 man-minutes; that current FMVSS Part 570 inspection standards provide a sufficient baseline for development of state inspection procedures for non-121 System-equipped trucks; that testing of 121 Systems can be performed in an inspection lane environment; that inspection and maintenance are hampered in many cases by inaccessibility of components of installed 121 Systems and other trucks and bus systems; that only visual procedures augmented with a minimal amount of specialized test equipment are usually required to perform a complete and thorough inspection for trucks and buses; and that District of Columbia inspection criteria and VIU inspection criteria are compatible. The management plan for the D.C. Truck and Bus Safety Inspection Demonstration Project is appended, as well as the inspection criteria, fleet maintenance records, inspection procedures for 121 Brake Systems, and the failure rate data summaries.

by E. Rucker; R. Wood
D.C. Dept. of Transportation, Office of Vehicle Safety Res., 301 C St., NW, Washington, D.C. 20001; Potomac Res., Inc., 7655 Old Springhouse Rd., Westgate Res. Park, McLean, Va. 22102
DOT-HS-7-01725
1978; 166p
Rept. for Nov 1977-Sep 1978.
Availability: NHTSA Technical Reference Service, Room 5108, 400 7th St., SW, Washington, D.C. 20590

HS-803 872

COST EVALUATION FOR FOUR FEDERAL MOTOR VEHICLE SAFETY STANDARDS. VOL. 2: APPENDICES. FINAL REPORT.

In a study of parts required to meet four Federal Motor Vehicle Safety Standards, the necessary parts were purchased for a representative sample of makes and models of vehicles, and the total consumer out-of-pocket costs estimated. The first year of the imposition of the standard and the year immediately preceding it were emphasized. These standards were: FMVSS 214, Side Door Strength; FMVSS 215, Exterior Protection; FMVSS 301, Fuel System Integrity; and FMVSS 208, Occupant Crash Protection. A weighted average was developed from the sample vehicles and applied to the total industry volumes to determine the out-of-pocket cost for the implementation of each standard. The weighted average of weight variance per vehicle due to implementation of each standard was also determined for FMVSS 214, 215, and 301. The series of appendices to the study includes 244 photographs of parts purchased to implement the standards: two- and four-door assemblies, front and rear bumpers, fuel tank assemblies, seat belt and air bag assemblies.

by Robert F. McLean; Clifford Eckel; David Cowan
John Z. DeLorean Corp., Res. and Engineering Div. DMC,
P.O. Box 427, Bloomfield Hills, Mich. 48013
DOT-HS-7-01767
1978; 254p
Rept. for Oct 1977-Oct 1978.
Availability: NTIS

HS-803 874

EFFECTS OF LOAD, INFLATION PRESSURE AND TIRE DEFLECTION ON TRUCK TIRE NOISE LEVELS. FINAL REPORT

SAE Recommended Practice J57a--Sound Level of Highway Truck Tires--specifies that tests be made using tires inflated to the maximum inflation pressure and loaded to the maximum load as specified by the Tire and Rim Association (T&RA). If local load limits preclude the use of the maximum rated load, tests may be conducted using lower loads if the inflation pressure is adjusted either to maintain constant tire deflection or according to the T&RA load inflation pressure tables. Whether these alternate load/inflation pressure conditions result in similar sound levels is an important question. This report presents acoustic data that allows evaluation of the equivalency of these alternate conditions. In addition, laboratory data on the relationships between load, inflation pressure, and tire deflection are presented. On the basis of these data, for tire loads greater than 70 to 75% of the maximum rated load, smaller variations of the measured sound level were observed when constant inflation pressure was maintained than when the inflation pressure was adjusted. This is convenient as it essentially represents the typical in-service case where the load varies between trips but the tire inflation pressure is maintained at a constant value. The SAE recommendation for measurement of truck tire noise is appended, as well as a description of the vehicle configurations, test tires, field test site utilized for data acquisition and the operational test procedure, with diagrams and photographs.

by R. D. Kilmer; M. A. Cadoff; D. E. Mathews; C. O. Shoemaker, Jr.
National Bureau of Standards, Washington, D.C. 20234
DOT-AS-60031
Rept. No. NBSIR-78-1570; 1979; 49p 19refs
Rept. for May 1975-Nov 1978.
Availability: NTIS

HS-803 875

LIFE CYCLE COSTS OF QUIETER TRUCK TIRES. FINAL REPORT

An evaluation is made of the economic impact of potential truck tire noise regulations through analysis of the life cycle costs associated with the utilization of various types of truck tires in over-the-road motor carrier operations. The basis for the life cycle cost calculations is actual fleet tire wear rate data--including tire use location, rotation sequence, pull depth strategy, recapping practices, etc.--from twelve major long-haul carriers located throughout the nation. Included is an overview of the typical tractor-trailer configurations and associated tire operational procedures, with a review of bias ply and radial ply tire wear and recapability characteristics. Comparison of the average cost per mile figures reveals that the radial rib tire use scenario is essentially equivalent economically to the bias-ply rib/bias-ply crossbar (current practice) scenario. Utilization of bias-ply rib tires at both steer and drive axle positions proves to be more costly. In addition to initial investment and replacement cost estimates, qualitative estimates of anticipated variation in maintenance, inventory and operating costs are made. Relative to bias-ply tires, radial tires have the potential for actually decreasing most of these cost factors. Assuming a reasonable lead time for the effective date of the regulation that would ensure the availability of adequate quantities of radial tires, total industry changeover to radial rib tires would have little economic impact.

by William R. Fuller
Wyle Res., 128 Maryland St., El Segundo, Calif. 90245
DOT-OS-70012
1979; 80p 19refs
Rept. for Dec 1976-Dec 1978.
Availability: NTIS

HS-803 876

TRUCK NOISE IV-H: POST-FLEET TEST RESULTS ON HEAVY DUTY DIESEL TRUCKS HAVING REDUCED NOISE EMISSIONS. FINAL REPORT

A research and development project was conducted to demonstrate diesel truck noise-reduction technology, using four over-the-road tractors modified to reduce noise levels within state-of-the-art technology. The truck used in the project was an International Harvester model COF-4070A (cab-over-engine) with a Detroit Diesel 8V-71N engine. Of two different types of modified trucks the nonenclosed type has close-fitting acoustical covers mounted to the engine, and the enclosed type has a partial engine enclosure mounted to the frame of the system. Modifications were also made to the cooling, exhaust and intake systems. Fleet test hardware was compared before going into service and when taken out of service, as were noise control equipment and noise levels (the in-service life being approximately three years and 400,000 miles). Fleet maintenance and operating costs for the quiet trucks were compared with comparable production vehicles. An increase in overall noise levels of both types of modified trucks after fleet service was due mainly to deterioration of engine modifications, which could have been prevented by proper maintenance. Better training of service personnel is recommended to maintain these engine modifications, as well as better sound-absorption material in an engine enclosure to prevent oil from being absorbed and presenting a possible fire hazard. The major problem encountered with the exhaust system was leaking exhaust joints. Mufflers were in good condition at end of fleet testing. Lighter mufflers or stronger exhaust system supporting hardware will eliminate fatigue failures in the muffler support system. A higher tear

strength, flexible rubber boot is required on the reduced noise level cooling system to allow utilization of the engine-mounted shroud. The intake system modifications performed very well and remained in good physical condition. The unmodified engine noise source did not change significantly in noise level during fleet operations. Fuel mileage was higher for the modified vs. nonmodified trucks. Maintenance costs of the enclosed trucks were much higher than the nonmodified trucks (\$.0378/mi vs. \$.0325/mi), with the nonenclosed trucks showing a smaller increase (\$.0328).

by T. J. Henry
International Harvester Co., Truck Div. Engineering, P.O. Box 1109, Fort Wayne, Ind. 46801
DOT-OS-20222
1979; 104p 6refs
Rept. for Mar 1977-Oct 1978.
Availability: NTIS

HS-803 878

FEASIBILITY OF CERTIFYING (DESIGNATING) MEDICAL EXAMINERS FOR INTERSTATE COMMERCIAL VEHICLE DRIVERS. FINAL REPORT

A study was made to determine the feasibility of establishing a system of certifying all physicians performing interstate commercial driver examinations. After consultation with the medical community, motor carrier management, and drivers' union representatives, it was concluded that a sufficient pool was not available to operate a certified medical examiner system for all interstate commercial driver examinations. Five alternative plans were proposed. The most acceptable was a system of certifying medical examiners at the third examination level, when a driver's physician and the motor carrier's physician do not agree on the driver's medical condition. Enough qualified physicians would be available, and the plan could be implemented by the Bureau of Motor Carrier Safety without any legislative or regulatory changes. Means for implementation of this plan, with budget estimates, are provided. It is recommended that a medical records depository be established to house all interstate commercial driver examination forms and provide baseline data not now available.

by Lee N. Hames; Elaine Petrucelli
Health and Safety Associates, Inc., P.O. Box 222, Morton Grove, Ill. 60053
DOT-HS-7-01762
1978; 129p 55refs
Rept. for Oct 1977-Jun 1978.
Availability: NTIS

HS-803 880

ALTERNATE ENGINES. STATE OF THE ART STUDY. FINAL REPORT

Eleven different advanced automobile engine types were examined for possible introduction prior to 1990; they were evaluated in terms of present research and development status, demonstrated and predicted characteristics, and weaknesses. The objectives were to assess the production potential in 1985 and 1990, and to assess the relative fuel economy gain (with exhaust emission constraints) compared to the moving baseline of the spark ignition engine. Conclusions represent what is believed to be achievable by a manufacturer on a practicable, cost-effective basis. An assessment of engine production potential was based on an extensive literature survey and extrapolation of learning

curves toward future values of fuel economy and emissions. Gas turbines and external combustion engines were determined unlikely to be in general use prior to 1990. Stratified-charge engines, advanced diesel engines, and internal combustion engines with variable displacement features were determined to be likely candidates for use prior to 1990. These engines were analyzed in detail, and learning curves were determined for fuel economy predictions with exhaust emission constraints.

by Roy A. Renner
South Coast Technology, Inc., P.O. Box 3265, Santa Barbara, Calif. 93105
DOT-HS-7-01790
1978; 84p 84refs
Rept. for Nov 1977-Nov 1978.
Availability: NTIS

HS-803 890

DEVELOP AND TEST AN ASSOCIATE DEGREE PROGRAM FOR TRAFFIC RECORDS ANALYST. FINAL REPORT

The third study in a series to explore the feasibility of a two-year associate degree curriculum in phases of highway safety was conducted by the American Association of Community and Junior Colleges (AACJC). An academic program for traffic records analysts, was outlined and offered to a number of community colleges. Some interest was expressed initially by two of the colleges, but lack of funding and of assurance of future employment led to discontinuation of the project. This study includes a review of the need for traffic records analysts; a description of the AACJC plan to select a pilot institution; recommendations for practices to be continued, eliminated, changed or improved; and a description of efforts made to pilot test the program. Appendices include the cover letter sent with "Guides of the Basic Course in Highway Traffic Records," and a list of the colleges to which it was sent.

by Richard E. Wilson
American Assoc. of Community and Junior Colleges, 1 Dupont Circle, Washington, D.C. 20036
DOT-HS-5-01239
1979; 27p
Rept. for 1 Jul 1975-31 Aug 1977.
Availability: NTIS

HS-803 961

MULTIDISCIPLINARY HIGHWAY COLLISION INVESTIGATION COURSE. FINAL REPORT

In an effort to provide training for traffic accident investigators and allied specialists, approximately thirty students were trained in each of three sections of a 2-week, 84-hour course. All necessary resources were provided by the contractor; course materials previously developed by Dynamic Science, Inc., were used. Major topics presented included: orientation; investigative techniques (classroom presentations and on-scene experience); human, vehicle and environmental factors; methods of accident data sampling; level II investigation; accident causation; collision severity; injury severity; and computer simulation models of accident reconstruction applicable to in-depth investigations. The final report covers a general introduction; purpose/objectives; technical approach; major topics, course hours, and allied areas; course outline; course planning and preparation; student evaluation; description of course sessions; course evaluation; program plan and schedule; conclusions, findings and recommendations. Both end-of-course and six-month follow-up evaluations were conducted. Most participants rated the course from

HS-803 962

"good" to "excellent"; general comments from those attending, and sample questionnaires, are appended.

by Jack D. Baird

Dynamic Science, Inc., 3440 Wilshire Blvd., Los Angeles, Calif. 90010

DOT HS-6-01512-Mod-3

1978; 22p

Rept. for 31 Jul 1977-31 Jul 1978.

Availability: NTIS

HS-803 962

DOMESTIC PASSENGER AUTOMOBILE WEIGHT PROJECTIONS, 1979-1986. GM, FORD, CHRYSLER, AMC. FINAL REPORT

Using publicly-available data through Jul 1978, an estimate of potential weight reduction which each manufacturer (General Motors Corp., Ford Motor Co., Chrysler Corp., and American Motors Corp.) might incorporate towards reaching the 1985 fuel economy goals was made, based on known product plans and available technology. Four weight categories (sedan and station wagon, with and without options) were calculated by make and model line for each model year, based on individual manufacturer's strategies of weight loss due to all new vehicle design, major sheet metal change, and component redesign and material substitution. Results are presented at the detail level by manufacturer and model and at the summary level by Environmental Protection Agency market class. Weight losses from 7% to 32% (depending upon vehicle size) were estimated. Appended are support documentation for component changes, 1978 baseline curb weights, projected engine improvement and weight differential data, and support documentation for projected curb weights.

by Theodore Taylor, Jr.; Madelyn C. Isaacs; Alan R. Cunningham

Corporate-Tech Planning Inc., 275 Wyman St., Waltham, Mass. 02154

DOT-HS-7-01789

1978; 178p refs

Rept. for Jun-Aug 1978.

Availability: Corporate author

HS-803 964

SAFETY RELATED RECALL CAMPAIGNS FOR MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT, INCLUDING TIRES REPORTED TO THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION BY DOMESTIC AND FOREIGN VEHICLE MANUFACTURERS, JANUARY 1, 1978 TO DECEMBER 31, 1978

Summary tabulations are presented of the motor vehicle safety defect recall campaigns for the year 1978, listing manufacturers reporting, both domestic and foreign, the number of recall campaigns and number of vehicles; equipment and tire companies are included. More detailed information is provided in the body of the report, giving the NHTSA identification number, date of company notification, make and model, model year, number of pages on file, number of vehicles recalled, and a brief description of the defect and the manufacturer's corrective action. Equipment and tire company recall campaigns are similarly detailed. Data on the status of recall campaigns as of 30 Sep 1978 are included.

HSL 79-11

National Hwy. Traffic Safety Administration, Washington, D.C. 20590

1979; 94p

Availability: GPO

HS-804 090

SPECIAL SPEED MONITORING SURVEY. TRUCKS AND BUSES

A special speed monitoring survey was included in the States' routine quarterly speed monitoring program, designed to help determine the speeds at which trucks and buses were traveling in general, the compliance level of the 129 motor-carrier members of the Voluntary Truck and Bus Fuel Economy Improvement Program, and to generate speed comparisons among trucks, buses and "all vehicles" on the same highway at the same time. State participation in the special survey was voluntary; 25 responded with data input, collected primarily during the third quarter of 1978. Only "free-flow" vehicle speeds are included, and the only constraints to speed were the driver's own choice and the 55 mph speed limit. Tables present data on state by state speed monitoring, speeds on main rural interstates, all vehicle average speeds by type of roadway, all truck and bus speeds, and Voluntary Program member speeds. The data indicate that speeds on interstate rural highways are higher than on other types with 55 mph speed limits; thus these data represent "worst case" conditions, with drivers normally driving fastest. In the Voluntary Program member fleets, distinguished for energy conservation efforts, the truck fleets showed lower average speeds than that for the total monitored, but the Voluntary Program bus fleets were worse offenders than all buses monitored. One hundred twenty-nine motor carriers are Voluntary Program members; 1063 of the 7393 trucks and buses monitored were operated by Voluntary Program members.

National Hwy. Traffic Safety Administration, Voluntary Truck and Bus Fuel Economy Improvement Prog., Washington, D.C. 20590

1979; 8p 1ref

Availability: Corporate author

HS-900 022

NEAR [NATIONAL EMERGENCY AID RADIO] MONITOR TRAINING PROGRAM FOR CB RADIO EMERGENCY MONITORS. 1. COURSE GUIDE

This manual has been developed as a guide to aid course administrators, coordinators, and instructors in setting up and administering a NEAR (National Emergency Aid Radio)/CB (Citizens Band) Channel 9 monitor training program. A description of the overall objectives and scope of the course, and suggestions for organizing the content of the course are provided. Ideal class make-up would include trained public safety personnel plus volunteer monitors with no specific training in emergency response. Much of the content of the two-hour classroom training session is presented in a 30-minute training film, "Help is NEAR," which describes several common highway-related emergency situations and demonstrates how the Channel 9 monitor can cut response time. The single instructor required should be experienced in Emergency Channel 9 monitoring activities and/or professional emergency response service; he should be thoroughly familiar with emergency response services within the area in which the trainees will work, and should preferably have past instructing experience. Trainees should have proficiency in speaking English clearly and distinctly, ability to take down information accurately, and a desire to perform up to high professional standards. A valid CB license is required. A

class size of 25 to 30 participants is recommended. The course graduate will have a thorough understanding of the role of the NEAR monitor, of the tools necessary to do the job, of the specific Federal Communications Commission rules that apply to Channel 9 use, and of communications techniques, information logging, and record-keeping, plus local requirements, if any.

REACT International, Inc.

1979; 10p

Clearinghouse Training Materials. Subject: Emergency Services. Format: Course Guide. Type of Audience: Citizens Band Radio Operators*. See also HS-900 023 and HS-900 024. Availability: GPO, stock no. 050-003-00336-1

HS-900 023

NEAR [NATIONAL EMERGENCY AID RADIO] MONITOR TRAINING PROGRAM FOR CB RADIO EMERGENCY MONITORS. 2. LESSON PLAN

This manual has been developed as an instructor's guide and lesson plan for training National Emergency Aid Radio (NEAR) Citizens Band (CB) Channel 9 monitors, both volunteers and public safety agency personnel. The lesson plan has been prepared to allow flexibility in covering the essential material thoroughly for all students without being too basic or too advanced. Much of the two-hour course is based on a 30-minute training film dramatizing typical emergency situations and demonstrating proper monitoring techniques, attitude, and reporting procedures. Course content and instructor guidelines are presented for conducting the classroom training session which is divided into three sections (introduction to course, presentation of film "Help is NEAR," and discussion of information presented in film). The course content material is presented exactly as in the Student Study Guide.

REACT International, Inc.

1979; 17p

Clearing House Training Materials. Subject: Emergency Services. Format: Lesson Plan. Type of Audience: Citizens Band Radio Operators*. See also HS-900 022 and HS-900 024. Availability: GPO, stock no. 050-003-00337-9

HS-900 024

NEAR [NATIONAL EMERGENCY AID RADIO] MONITOR TRAINING PROGRAM FOR CB RADIO EMERGENCY MONITORS. 3. STUDENT STUDY GUIDE

This manual has been developed as a study guide for National Emergency Aid Radio (NEAR) Citizens Band (CB) Channel 9 monitor trainees. The basic rules, tools, and techniques used by CB Channel 9 monitors are outlined, and the five most common kinds of highway-related emergency calls are discussed (i.e. highway accident or medical emergency, disabled vehicle (not blocking traffic), disabled vehicle (blocking traffic), careless or reckless driver, and traveler assistance). Much of the two-hour classroom training session is based on a 30-minute training film, "Help is NEAR," and the discussion that follows. There are also classroom exercises designed to aid the trainee in practicing monitoring procedure and techniques under the supervision of a skilled communicator. The course content material corresponds exactly to that in the instructor Lesson Plan. By the end of the course, the participant will possess the necessary knowledge of the tools, rules, and techniques for NEAR/CB Channel 9 emergency monitoring.

REACT International, Inc.

1979; 17p

Clearinghouse Training Materials. Subject: Emergency Services. Format: Student Study Guide. Type of Audience: Citizens Band Radio Operators*. See also HS-900 022 and HS-900 023.

Availability: GPO, stock no. 050-003-00338-7

HS-900 028

HIGHWAY TRAFFIC SAFETY SELF-INSTRUCTION COURSE. MODULE 1 WORKBOOK. STATE HIGHWAY SAFETY PROGRAM. 1ST ED.

This workbook, to be used in conjunction with a script on tape cassette, provides an individual private learning system which presents an overview of the State Hwy. Safety Prog. for persons concerned with highway safety within the U.S. This module covers the following aspects of the State Hwy. Safety Prog.: requirement as established and amended by public law, responsibility of the Governor of each state, process of establishing a State Hwy. Safety Prog. Office and the assignment of highway safety responsibilities, staffing and skill requirements of State Hwy. Safety Office personnel, magnitude of a Hwy. Safety Prog., necessary involvement of state organizations, role and involvement of local jurisdictions, role of civic and private groups, role of advisory committees, goals, function of the Annual Work Prog., function of the Comprehensive Plan, role of Federal Hwy. Administration/National Hwy. Traffic Safety Administration, role of regional offices, role of Hwy. Safety Standards, and role of Motor Vehicle Use Standards.

by Louis R. DeCarolus

Transportation Safety Inst., Oklahoma City, Okla.

1979; 52p

Clearinghouse Training Materials. Subject: Highway Safety Program*. Format: Workbook. Type of Audience: Highway Safety Personnel*. See also HS-900 029 and HS-900 030.

Availability: NHTSA General Services Div.

HS-900 029

HIGHWAY TRAFFIC SAFETY SELF-INSTRUCTION COURSE. MODULE 2 WORKBOOK. HIGHWAY SAFETY STANDARDS. 1ST ED.

This workbook, to be used in conjunction with a script on tape cassette, provides an individual private learning system which presents an overview of Hwy. Safety Standards for persons concerned with highway safety within the U.S. This module covers the following aspects of Hwy. Safety Standards: Federal requirements for their issuance, Federal requirements for their implementation, role of National Hwy. Traffic Safety Administration/Federal Hwy. Administration in administering Standards, scope and magnitude of the 18 Hwy. Safety Standards, how the Standards are interrelated, role of the states in implementation, and use of the National Driver Register.

by Louis R. DeCarolus, ed.

Transportation Safety Inst., Oklahoma City, Okla.

1979; 157p

Clearinghouse Training Materials. Subject: Highway Safety Standards*. Format: Workbook. Type of Audience: Highway Safety Personnel*. See also HS-900 028 and HS-900 029.

Availability: NHTSA General Services Div.

HS-900 030

**HIGHWAY TRAFFIC SAFETY SELF-INSTRUCTION
COURSE. MODULE 3 WORKBOOK. MOTOR
VEHICLE SAFETY STANDARDS. 1ST ED.**

This workbook, to be used in conjunction with a script on tape cassette, provides an individual private learning system which presents an overview of Motor Vehicle Safety Standards for persons concerned with highway safety within the U.S. This module covers the following aspects of Motor Vehicle Safety Standards: Federal requirements for their issuance, scope, role of Standards in highway safety, the Motor Vehicle Information and Cost Savings Act, and associated motor vehicle safety regulations.

by Louis R. DeCarolus, ed.
Transportation Safety Inst., Oklahoma City, Okla.
1979; 88p
Clearinghouse Training Materials. Subject: Motor Vehicle
Safety Standards*. Format: Workbook. Type of Audience:
Highway Safety Personnel*. See also HS-900 028 and HS-900
029.
Availability: NHTSA General Services Div.

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November 30, 1979

VERKEHRSBEEINFLUSSUNG AUF AUTOBAHNEN
UND SCHNELLSTRASSEN)

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AUTOMAKERS

SECRET CAR WARRANTIES-FREE REPAIRS THE
AUTOMAKERS DON'T PUBLICIZE

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AUTOMATION

TESTING AND AUTOMATION [AUTOMOBILE IN-
DUSTRY]

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AUTOMOBILE

ASSESSMENT OF THE EFFECTS OF SHORT TERM
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